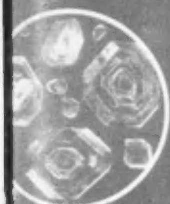
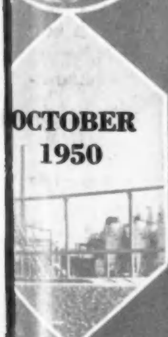
Chem

Read **A Laboratory Is Built**

CHEMISTRY





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Spirit of Research

THE SPIRIT of research is essentially a search for truth. We need more knowledge on a great variety of subjects, for our technology has come close to using up our backlog of latent information. This is why we find new research laboratories springing up, and their directors protesting their purity of motive. One might be tempted to think they want their work to be as useless as possible. Actually, the difference between pure and applied research is a time interval, for we manage to find a use sooner or later for almost everything we know.

To rebuild our margin of general knowledge about the fundamental properties of matter, we need not only expanded facilities for work and enthusiastic crews of alert young scientists. We need to rebuild an intellectual climate in which research can flourish. We need accurate information made freely available.

The atmosphere of secrecy for its own sake, often cloaking lack of understanding, which has risen over scientific knowledge in many quarters, is detrimental. The habit becomes strong to evade and equivocate, to tell half-truths and make a mystery of information. For today's advantage, this attitude is exchanging tomorrow's downfall.

Industrial laboratories, projected with vision and dedicated to a fearless search for information, can help to restore a climate in which research can flourish. The wide variety of products turned out by modern industry insures a wide interest in fundamental properties of materials. The rapidity with which new products can be absorbed by our technical civilization encourages the following of new leads. Industries using their great resources for the increase of knowledge are to be congratulated on their opportunities for accomplishment.

CHEMISTRY

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***Editors*: WATSON DAVIS and HELEN MILES DAVIS**

***Consulting Editor*: PAULINE BEERY MACK (Editor 1927-1944)**

➤ CRYSTAL MODELS *help Dr. W. L. Roth, of the Metallurgical Division of General Electric's Research Laboratory, see how X-rays are scattered and reflected by crystal planes. He sits before the X-ray Spectrogoniometer, a machine which measures the angles at which the rays are scattered. Crystal measurement is one of the methods by which more is learned about structure and composition of metals and alloys.*

A Laboratory Is Built

➤ IN SPITE OF costing eighteen million dollars, the new research laboratory which General Electric has just built at "The Knolls," near Schenectady, is the substance of a dream. Congealed in ceramics and metal, the new building encloses a place "where scientists can explore untrodden paths."

How the company and its dream came into being a little over a half-century ago, and their share in the development of our technical way of life, is reviewed as the new laboratory starts its work.

As the nineteenth century came to a close, the development of the electrical industry was just beginning. A number of companies were being built around the pioneers who had contributed such inventions as the arc

light, the transformer, the incandescent lamp and the electric street car.

In 1892 two of these, the Edison General Electric Company, which had been formed to promote Thomas Edison's incandescent lighting, and the Thomson-Houston Company, based on Elihu Thomson's arc-lighting system, combined to form the General Electric Company, whose headquarters were established in Schenectady, New York.

Among this new company's pioneers were its first president, Charles A. Coffin, financial genius of his day; Dr. Elihu Thomson, first great scientist to devote himself to industry; E. W. Rice, Jr., Thomson's former pupil and righthand man, who became technical director of the new company; the brilliant mathematician and engineer, Dr. Charles P. Steinmetz; Albert G. Davis, patent attorney, who stimulated much engineering and invention; and many others.

With the approach of the Twentieth Century, these men surveyed their work and found something lacking. They recognized that engineering is applied science; hence basic scientific knowledge is needed if engineering is to advance. Progress which they were then making was based upon the work of men such as Joseph Henry, Michael Faraday, Allessandro Volta, Georg Simon Ohm, Andre Marie Ampere, James Clerk Maxwell, and many others, most of whom had done their work in the early part of the 19th Century.

Who, the G-E leaders asked themselves, was engaged in the same sort of fundamental science, contributing the foundations on which engineering of the future would be built? They could see very few.

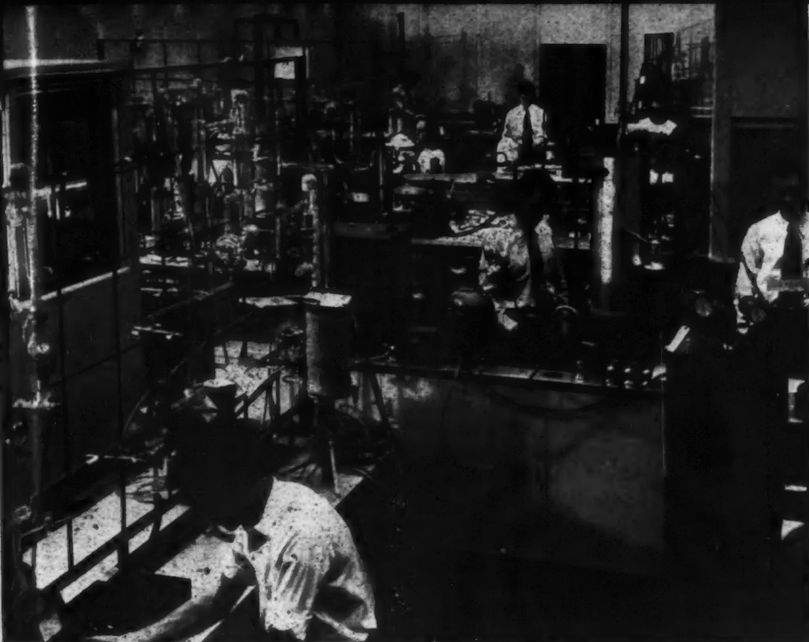
Indeed, at that time, there was a strong feeling among scientists, particularly in the field of physics, that all the important work had been done; that the future would merely make refinements, and add more decimal points.

But Rice, Thomson, Steinmetz and Davis, men who were so vitally concerned, did not share this pessimistic view. They decided that General Electric would establish its own research laboratory, the first industrial research laboratory in America.

What they had in mind was something entirely different from the development or testing laboratories then operated by G.E. and other companies. It was to be a laboratory where scientists would explore untrodden paths of science; where they might find the new ideas which others could develop and put to work.

Having decided to establish the laboratory, the next problem was the proper man to head it. Dr. Thomson nominated a young professor of chemistry at the Massachusetts Institute of Technology whom he had met and admired—Dr. Willis R. Whitney. Rice interviewed him, and also was favorably impressed. Whitney was offered the position.

It took some persuasion, for Whitney was happy at M.I.T. and enjoyed teaching—indeed, he had once said that he would rather teach than be president. Moreover, he was not sure that industry could provide enough problems to keep him busy and happy. Rice then suggested he begin on a trial basis, dividing his time each week



▸ PROPERTIES OF METALS *are under investigation in one of the rooms of the new General Electric Research Laboratory recently dedicated. Surface properties, heat capacities and structure are among the points on which more information is wanted for present day needs.*

between Boston (where M.I.T. was then located) and Schenectady. Whitney accepted this proposal and arrived in September, 1900 to start work.

The home for the infant laboratory was a barn in back of Steinmetz' Schenectady home, on the bank of the Erie canal. Whitney also obtained the services of Tom Dempster as his assistant. Dempster, still living, was the laboratory's first employee.

For three years Whitney commuted between Boston and Schenectady. He familiarized himself with the company's problems and initiated experiments to throw light upon some of them. He soon decided there was plenty to keep him busy, and that he would make it a full-time job. However, M.I.T. was reluctant to let him sever all connections, so he was appointed "Non-Resident Professor of Chemical Research." The M.I.T. catalog still lists him in this post, making him by far the senior member of its faculty.

Electric lighting, one of the most important activities of the General Electric Company through its history, engaged the attention of the Research

Laboratory from the start, even though many people in 1900 believed that Edison's latest carbon filament incandescent lamp was nearly perfect and incapable of much further improvement.

Whitney, however, developed the metallized carbon filament, used in the "Gem" lamp, introduced in 1905. This gave 25 per cent higher efficiency —25 per cent more light for the same consumption of electricity than its predecessors. This was achieved with the same life—nearly five times the life that could be obtained with the same efficiency of the older lamps.

But the Gem lamp itself was soon to be replaced by a far greater improvement. Many scientists had appreciated the advantages of metal filaments over those of carbon, but they were most difficult to make. Despite this, there appeared in Europe a series of lamps, with filaments of such metals as tantalum, osmium and tungsten.

Though these were highly-efficient light producers, they were all subject to many disadvantages. Tungsten was best but it was an extremely brittle metal which would not stand mechanical working. The first filaments were made by preparing a paste of tungsten powder, squirting this through a die to form a thread, then heating the thread to drive out the binder and make the tungsten particles cohere into a filament.

These were very fragile, and broke easily in shipment, or in any application which involved any mechanical shock. Nevertheless, their superiority in light production led to large numbers of such lamps being used.

In 1905 Whitney had persuaded another M.I.T. chemist, Dr. William D. Coolidge, to join his growing staff. Coolidge became interested in the lamp problem and soon was able to make a considerable improvement in the process of making squirted filaments. Even though these were stronger than the old ones, he was not satisfied. If only tungsten were not so brittle, he thought, if only it could be drawn through a die to make a wire, using the same process employed for other metals, what a vast improvement would be made.

By 1908 his researches had borne fruit. He had developed a means to make tungsten ductile, and thus tungsten wire filaments became possible. Lamps equipped with them were introduced in 1910. They were well able to withstand fairly rough treatment; in fact, the glass bulb would now break before the filament did.

Serendipity

The next big improvement in incandescent lamps from the laboratory came as a result of the work of Dr. Irving Langmuir. He came to Schenectady from Stevens Institute of Technology in July, 1909, to spend the summer vacation but decided to remain. Langmuir's improvement was a good example of one of his favorite words—"serendipity"—which is characteristic of much research.

Serendipity, found in the larger dictionaries, was introduced in the 18th Century by Horace Walpole, who took it from a story about three princes of Serendip, an old name for Ceylon. They travelled about the world, looking for things which they

seldom found, but usually stumbling across others that were equally interesting. Langmuir defines serendipity as "the art of profiting by unexpected occurrences."

In 1909 lamp engineers thought a better vacuum was needed to make a better lamp. To find whether this might be a hopeful solution, Langmuir set out to study the basic effects of a number of different gases in experimental lamps at a variety of degrees of vacuum. From this came a series of technical papers on chemical reactions at low pressures—but no improvement in lamps.

After a few years of this, it seemed to Langmuir that his work was leading nowhere, and he so reported to Whitney. The director reassured him by saying that, as far as he was concerned, it didn't make any difference whether it led anywhere or not. He would like to see Langmuir continue working along any fundamental lines that would yield additional information regarding the phenomena taking place in incandescent lamps. He told Langmuir to feel perfectly free to go ahead on any such path that seemed of interest.

"In adopting this broad-minded attitude," Langmuir wrote later, "Dr. Whitney showed himself to be a real pioneer in the new type of industrial research."

Langmuir's work eventually showed that a better vacuum was not needed. Instead, a lamp, actually with less vacuum but containing an inert gas such as nitrogen, gave much better results. Introduced in 1913, the gas-filled lamp increased many times the efficiency of electric lamps.

It permitted extension of street lighting to nearly every street in cities and villages throughout the country. It raised lighting levels in workshops, schools, offices, and homes. It made possible the development of the portable projector for home movies.

Atomic Hydrogen Welding

In connection with his work on heat losses from hot filaments, Langmuir had found that the heat liberated when two atoms of hydrogen combine to form a molecule is considerably greater than that produced when the molecule combines with oxygen to burn in the usual way, forming a water molecule. This discovery led to the atomic hydrogen welding torch.

In this useful device, a stream of hydrogen gas is passed through an electric arc, formed between two tungsten electrodes. The hydrogen, which is in the form of molecules, is quickly broken into two separate atoms. However, as these leave the arc, they quickly recombine and produce a flame far hotter than ordinary welding flames.

In addition to the high temperature, there is the further advantage that air, which contains 71 per cent of nitrogen, as well as oxygen, is kept away from the weld by the hydrogen cloud. This prevents formation of nitrogen-containing compounds which would weaken the weld.

Atomic hydrogen welding made possible for the first time the easy welding of aluminum and chromium and other hitherto unweldable metals and permitted welding of extremely-thin sheets of metal, which by other processes would be burned.

Coolidge X-Ray Tube

After Coolidge had developed his ductile tungsten, which proved so valuable in the incandescent lamp, he turned to seek other uses for this novel material. He found that it made an excellent target for X-ray tubes. It is from the target, enclosed in an evacuated bulb and bombarded by a stream of high-voltage electrons, that X rays are emitted. But X-ray tubes of that day, even with a tungsten target, were erratic affairs, chiefly on account of the way the electron stream was formed.

This involved a rather complex process, first with the cold aluminum cathode, where the electrons originated, and then with the small amount of residual gas remaining within the tube. Coolidge realized that if the gas were completely eliminated, the tube would be much more reliable. Unfortunately, gas seemed to be essential in producing the electrons.

But electrons could be produced in another way. Utilizing a discovery made by Edison some years before and known as the "Edison effect" physicists had found that they could be boiled out of a hot filament, like that of an incandescent lamp. This would work even in the highest possible vacuum. Coolidge saw that it was the solution to his problem.

Thus was born the Coolidge X-ray tube, introduced in 1913. At one end of such a tube, which is exhausted to a very high vacuum, there is a small tungsten filament, supplied with a relatively low voltage to heat it to incandescence. Between the filament, and the tungsten target at the opposite end of the tube, high voltage is applied. The electrons, of low energy as they are emitted from the filament, are picked up and hurled against the target—and X rays are generated.

Before many years had passed, the reliability and ease of control of the Coolidge tube had led to its replacing older types in practically all applications.

At about this same time, Langmuir was working on another problem also concerned with electrons and gas in tubes. DeForest's audion, the prototype of tubes used in modern radio sets, had just been introduced. It was used both to detect the incoming signals and to amplify them, but its output was low in power. Like the pre-Coolidge X-ray tubes, the audion also had to have in it a small amount of gas or it would not function.

Langmuir found the trouble. Even though electrons were emitted from the filament with the highest vacuum, they tended to accumulate around the heated filament. They formed a "space charge", which repelled additional electrons as they sought to leave the filament. If some gas were present, enough electrons were used up in knocking the gaseous atoms apart that the space charge did not form.

The solution found by Langmuir was to place the various parts of the high-vacuum tube close together. Then the electrons did not have far to travel. Using extra high voltage to pull them across the intervening space, the effect of space charge could be eliminated, and the tubes could operate at high power.

Langmuir's high-vacuum power tube permitted use of high voltage in radio sending and receiving for the

first time, gave modern broadcasting its "heart," and is regarded as probably the greatest single factor in development of that field.

Following these pioneer studies by Langmuir and Coolidge, electronics continued to engage the attention of a large laboratory group. Dr. Albert W. Hull, who joined the laboratory in 1914, and who for a number of years was assistant director, is credited with inventing more types of electron tube than any other man.

One of these was the thyratron, used in controlling heavy currents like those in large motors in industry. Another was the original form of a tube called the magnetron. With modifications introduced later by a number of scientists, it played a vital part in our wartime radar.

Curiously, it also had an exactly contrary military use. As a result of further developments by Hull and a group working under him during World War II, it proved a useful means of generating powerful jamming signals to render enemy radar useless.

Further modifications of these jamming tubes have been made so that now they are used in industry to produce radio waves a few inches long, and with a power of five kilowatts. These are employed for rapid and uniform heating of plastics and similar materials. A 50-kilowatt tube has been developed also, but industry has not yet found out how it can be applied.

Another Hull invention was the screen-grid tube. This made it possible for home radio receivers to give better reception, with fewer tubes than they formerly required, thus giving the user more for his money than ever before.

The Research Laboratory now has grown from its original staff of one man and a helper to more than 1200 persons, from a home in an old barn to a multi-million dollar plant on an 180 acre estate, from work in a few fields to that in many fields ranging from atomic energy to electronics—from new alloys to weather research—from new insulations to refinements in television—from machines that duplicate the senses to those which produce X rays of hundreds of millions of volts—from millionth-of-an-inch thin films whose colors tell temperature to studies of the activities of various materials at very low temperatures.

Such is the panorama today. But despite the expansion to many fronts, the basic philosophy of free, untrammeled research still continues. In a recent statement, Dr. C. G. Suits, vice president and director of research, said:

"Scientists in the General Electric Research Laboratory, have at least as much academic freedom as they would in a large university whose activities are similarly diversified. Because of the great diversification of the General Electric Company's business, this freedom is possible. Our research scientists have the unique opportunity of exploiting practically all fields of physical science—they do not have to keep their work to a few fields which are obviously of direct value in the company's business.

"In a large proportion of the Laboratory's work, the criterion is wheth-

er the proposed investigation offers the possibility of acquiring new knowledge, and it is not necessary to specify in advance whether it will find some application in connection with products or business of the company. Indeed, experience has shown that there have been some applications from almost every field in which the Laboratory has worked. Obviously, in a company without such great diversification, the Research Laboratory would not have such opportunities for freedom.

"Not only does the scientist not need to promise in advance what will come of a research project, but often, even after it is done, it is still not clear where and how it will be applied. Thus, Langmuir's work on high vacuum led to the high-vacuum, high-power electron tube, which eventually made possible reliable radio communication over long distances and modern applications of industrial electronics, as in heating methods. Similarly, his studies which led to atomic hydrogen welding opened up a new industry, though this was not apparent when the work was being done.

"Freedom works both ways. Because of the freedom, like that afforded Langmuir in the instances cited, the company became more diversified. On the other hand, the more diversified it becomes, the more freedom can be given.

"Investigations into the atomic nucleus which are now being carried on in the Research Laboratory are a good example of present work of which the outcome is quite unpredictable. The same is true of Project Cirrus, (weather research) which is entirely exploratory in nature. The same is true of studies which are being made of the effects of radiations upon living cells, and also of the phenomena which occur at very low temperatures, near absolute zero.

"New subjects of investigation generally come from the members of the staff, and are not dictated from above. However, it is the job of the director to see that important fields are not neglected, and that they are studied even when not very glamorous. An example is work on methods of light production. Even a one per cent increase in the efficiency of a phosphor used in fluorescent lamps would result in a saving to the U.S. public of above $20 million each year. Thus, some laboratory activity must be channeled into fields that are important to the company, but even here the research man has freedom in the way he attacks the problem."

On the Back Cover

➤ MORE LIGHT *for mankind comes from phosphors, which turn invisible radiation into light. Improved illumination for fluorescent lamps and television pictures results from development of better phosphors. Dr. Lewis R. Koller of General Electric examines a phosphor-coated glass plate glowing in the rays from the ultra-violet lamp below.*

RW — Radiological Warfare — Would Use Fission Debris From Atomic Pile

"Death Sand" is Atomic Danger

➤ An invisible dust of radioactive "death sand" could spread over cities of the earth and kill their populations by radioactivity without the noisy warning of an atomic bomb.

Such new kinds of atomic weapons known as RW agents, are being studied by the Atomic Energy Commission. RW is short for radiological warfare. RW agents are not atom or hydrogen bombs. They consist of materials made radioactive in nuclear reactors.

Attention was focussed on them by a sentence in the eighth semiannual report of the AEC to Congress. The sentence merely states that "studies on the feasibility of radiological substances as a method of warfare were continued."

Early in 1950 the then Secretary of Defense Louis Johnson reported on the subject in some detail.

"The possibility of radiological warfare is another outgrowth of atomic energy applications for national defense," he stated. The objective of this form of warfare would be to make a given area untenable through the presence of radioactive particles, called RW agents.

He warned that "every atomic pile of suitable size, irrespective of its design or purpose, is a potential source of significant quantities of RW agents and RW weapons could become available to another country whether or not they produced an atomic bomb."

At present, RW is a "mystery weapon," he said. It could therefore cause panic unless people are informed about it. Chief reassurance to those who are frightened by the possibility of RW is his statement that "orderly evacuation from contaminated areas should be possible."

Dr. Louis N. Ridenour, dean of the University of Illinois Graduate School, writing in the Bulletin of the Atomic Scientists, cites a brief paragraph in the famous Smyth report of 1945 and an Austrian discussion of 1948 by Dr. Hans Thirring. He concludes that insidious use of the fission products of nuclear reactors would be a difficult weapon to use because of delivery to the target, chemical separation of the poisons and amounts available (enough for only two or three major cities a month).

This use of radioactive poisons in warfare is different from the radioactivity produced by atomic bomb explosions, whether the radiation of the bomb itself, the induced radioactivity in materials of the target city, or in chemical elements placed in the bomb to produce enhanced radioactivity.

What would be done would be to collect the debris of smashed uranium atoms from atomic "furnaces" in which fissionable material is being "burned." About a dozen of these fission products would be useful in warfare. These emit beta rays (electrons) or gamma rays of substantial energy, and half of their substance would be

disintegrated in periods from about a week to a year.

Very fine sand would be coated with these radioactive poisons and spread very thinly over the area where it is desired to wipe out life.

The person in a poisoned area has no way of knowing that he is in danger either by the evidence of his senses or by any unsophisticated tests. He may receive a lethal dose of radiation before he knows that he is endangered, and yet a few days later he may die. Radioactivity detectors would tell of the danger. If a person is aware of the danger he may survive if he flees the area at once with a dampened handkerchief over his nose and mouth. Walls of a sturdy building or even heavy clothing would lower exposure risk, but half an hour of breathing of dust stirred up by passing winds would give a fatal internal dose.

Radioactive "death sand" because of its novel and unique properties may be useful in special situations, but its proper use in war would be very difficult.

The "death sand" is prepared by drying fission product salt solutions on sand or metal powder. It is described as the lightest and most transportable of all the weapons of mass destruction. A highly deadly layer on the surface of the ground would weigh only 12 milligrams per square meter and would be quite invisible.

Enough radioactive fission products are produced each month at the Hanford, Wash., plant to contaminate 144 square miles, or more than six and a half times the area of Manhattan.

The atomic weapons effects handbook issued by the Atomic Energy Commission and Department of Defense says that radiological warfare is possible as a "mystery weapon" of any future conflict, and warned that the country must take it into account in planning atomic defense. But the handbook cites great difficulties which stand in the way of using the weapon.

Who will do the spreading of the deadly materials, and how? The weight of the delivery mechanism would be enormous. From it, a relatively small amount of material would have to be spread uniformly over a wide area.

Moreover, radiation's effects are delayed. They do not mean sudden death. A city or battlefield poisoned by radioactivity could still be used if rescue teams or troops are rotated every few days. The materials themselves, made in an atomic pile, would gradually decay. And the making of them would require vast amounts of power in an atomic pile.

The report estimates that a nuclear reactor operating for 100 days with a power output of a million watts would produce materials with only one-hundredth of the radiation energy of the fission products of an atomic bomb.

Nevertheless, warn the atomic scientists, the panic-inspiring potential as a mystery weapon such as poison gas became in Word War I makes radiological warfare a grim possibility to be included in civilian defense planning.

"While it is impossible to predict whether radiological warfare will be used or not," says the report, "it is necessary to understand and be prepared for it."

The price of such world suicide is about $40,000,000,000 and the work of a few years by a major power. And even then the money and time might be wasted, in the opinion of Dr. James R. Arnold, member of the staff of the Institute for Nuclear Studies at the University of Chicago.

Dr. Arnold commented specifically on a statement by Dr. Leo Szilard last Febraury, that a huge hydrogen bomb with a casing of cobalt could produce trillions of fine particles of radioactive dust. This dust, he said, if spread by the winds evenly over the face of the earth, could kill every human being.

Dr. Arnold concludes that it would take a bomb ranging in size from one-quarter as big as the 40,000-ton battleship Missouri to two-and-a-half times the size of the Big Mo to do the job. Even then, he says, it is a question whether the neutrons produced by the fusion of the heavy hydrogen in the bomb would be absorbed by the cobalt so as to give rise to a dangerous radioactive isotope.

However, if that happened, he goes on, Dr. Szilard's assumption that the cobalt dust could be effectively distributed around the earth in the atmosphere is incorrect. Dr. Arnold says that the particles could be rained out of the atmosphere, or made harmless by other natural means before they spread evenly.

Dr. Arnold concludes that the world is in no immediate danger. He and Dr. Szilard agree that it would be much harder to build a bomb of the type that would confine its horror to one continent than it would be to build an undiscriminating bomb.

However, Dr. Arnold says: "advances are to be expected, and a repetition of this discussion ten years from today may give very different results."

Liquid Ammonia for Crops

➤ THE NITROGEN requirements of crops can now be met much more economically through the use of liquid ammonia than by solid fertilizers.

The first direct use of liquid ammonia in agriculture occurred only 16 years ago in California, said a report to the American Chemical Society by A. L. Mehring and Gae A. Bennett of the United States Department of Agriculture's Division of Fertilizer and Agricultural Lime, Beltsville, Md. This use has grown so rapidly in recent years that production for the year ending June 30, 1949, reached a peak of 69,000 tons.

This usage will undoubtedly continue to grow if ammonia remains substantially cheaper than sodium nitrate, ammonium sulfate and similar materials.

Liquid ammonia is run into irrigation water from steel cylinders. In the past few years liquid ammonia has also been used in special equipment for direct application to soil, especially in the Pacific Coast States and in the Mississippi Delta Area. The low cost of liquid ammonia induces farmers to make the necessary investments so they can handle it on the farm.

Better Animal Food, New Adhesives, Better Bread, Oil From Sunflowers

Chemical Advances in Many Fields

Reports of some of the developments reported at the Chicago meeting of the American Chemical Society are continued in this issue. Other highlights of the meeting were reported in CHEMISTRY *for September.*

Fatter Animals With Less Feed

➤ FARMERS may now obtain uniform growth increases in farm animals by feeding them rations containing an Animal Protein Factor supplement made by a primary fermentation process.

This new product has been demonstrated in laboratory and field tests to perform at least as well as other commercial materials, including APF supplements from antibiotic by-products, three scientists of U.S. Industrial Chemicals, Inc., H. M. Hodge, C. T. Hanson and R. J. Allegeier report.

The fermentation process used in making the new feed supplement, now in commercial production, differs from other APF processes in that it is anaerobic, or produced by bacteria without free oxygen.

Since primary fermentation permits complete control of the process, it offers flexibility for the inclusion of other new and promising factors. The commercial product carries a guaranteed amount of vitamin B_{12}, which is the most important component of the APF complex.

The uncertainty in the supply of animal and marine proteins, which have been used in manufactured feeds, and the consequent rise in prices for these materials, stimulated the development of certain types of APF supplements which, in some cases, have not given the expected results in practical field performance, the paper reported. "Our investigations have revealed the APF supplement from primary fermentation is significantly consistent in behavior, and produces more weight with less feed."

Liquid Adhesive

➤ NEW heat-sealing adhesives in the form of milk-like liquids reduce the costs and simplify the processes of packaging and of making labels.

The new materials, called polyamide resin suspensoids can be readily spread on paper, plastic film, or metal foil and, when heated, melt to a continuous adhesive layer which is not affected by water, water vapor, grease, oil, or corrosive solvents, it was reported by Dr. Harold Wittcoff of General Mills, Inc., Minneapolis.

The polyamide resins are made from soybeans or other vegetable oils combined with the chemical ethylene diamine. They are already used as paper coatings, adhesives, laminating resins, glossy package coatings, leather impregnants, coatings for metal surfaces, and vehicles for printing inks. The resins are applied by either heating and pressing onto the surface to be treated or by dissolving in alcohol.

The big advantage of the new so-called suspensoids is that they are

liquids ready to be applied. They consist of tiny particles of the resins suspended in water. Even though the polyamide resins are not soluble in water, the suspensions are stable, that is, the particles remain suspended and are not affected by freezing, thawing, continued heating, or vigorous stirring. The new liquid form eliminates the expensive operation of applying the "hot melt" or it substitutes water for the expensive, flammable solvent otherwise necessary.

Sunflower Oil

➤ SUNFLOWER seed promises to become an important source of edible oils, Ingmar Sollin and Dr. Carl O. Clagett reported.

From laboratory studies at the North Dakota Agricultural College, the oil content of the Advance and Sunrise varieties of sunflower seeds was found to be approximately 30 per cent of the total weight of the seed, and that of this oil content approximately 75 per cent is linoleic acid. Linoleic acid is a major constituent of edible oils.

Because the oil is less subject to flavor reversion than some other edible oils, it should find increased use in foods where flavor reversion is a problem. Among the suggested uses for sunflower seed oil are margarines, lard substitutes, salad dressings, French-frying of foods, oil packing of foods, and carrying agent in pharmaceuticals.

Potential applications of this versatile material do not end there, however. As a semi-drying oil it is of interest to the paint industry, being especially useful in the formulation of enamels because it does not break down chemically when exposed to high temperatures in baking, or yellow with age. It does impart an elasticity which is highly resistant to cracking or checking.

Electronics Stop Spoilage

➤ ELECTRONICALLY-TREATED foods have been found fresh and appetizing after as much as four year's storage without refrigeration. High speed electrons can also sterilize drugs and produce effective vaccines.

The electronic bombardment, fired in bursts lasting only one millionth of a second, sterilizes meat, fish, vegetables, fruits, and dairy products without destroying their enzymes reported Dr. Wolfgang Huber, Frederick B. Traub, Ullrich Friedemann, and Arno Brasch of the Electronized Chemicals Corporation, Brooklyn, and the Jewish Hospital of Brooklyn. Enzymes once thought to be the cause of spoilage are naturally occurring chemical agents which promote life processes.

The bombardment is produced by means of a machine called a capacitron, a self-contained unit with high enough radiation output to make it applicable to large volume industrial processing. The use of the capacitron for sterilization has been developed over the last few years because insects and microorganisms which cause spoilage of foods are susceptible to its radiation, whereas tissues, nutrients, and enzymes are much more resistant.

A highly potent rabies vaccine is produced by the electronic radiation, which destroys bacteria and viruses without harming the so-called antigens, the effective agents in the vaccine, it was reported.

Complete or partial inactivation of enzymes has been considered essential for the preservation of perishable substances, drugs as well as foodstuffs. Radiation treatment of such items with the methods described showed, however, that the dreaded "autolysis," or self-digestion, did not occur even after storage at room temperature of raw or precooked meat products for as long as four years.

A year or more after irradiation and storage, there was no change in taste and appearance in beefstew, raw ham, raw pork and veal muscle, chicken-a-la-king, gizzards, raw and ground liver, raw chopped beef and luncheon meat. The enzymes could be transplanted and were fully active, but the meat was fresh, appetizing and unspoiled. Fish, dairy products, and various vegetables and fruits gave the same results.

Cheaper Paints and Plastics

➤ MORE economical production of pharmaceuticals, plastics, and synthetic paints and varnishes is the result of a new method for the production of the compound acetaldehyde.

The new method is a more advantageous and economical process in comparison with the older methods of manufacture, report Professor James M. Church and Dr. Hanamant K. Joshi of the department of chemical engineering at Columbia University.

The older method for making acetaldehyde was the reaction of acetylene with water. This was used in the development of acetylene chemistry by the Germans during World War II. Prior to World War II another method was developed in this country. It uses air oxidation of ethyl alcohol obtained chiefly from the fermentation of grain and molasses. Nearly one-half of the yearly production of acetaldehyde is from this source.

Acetylene gas, due to its inflammability and explosiveness, is dangerous to handle, and the reaction with water results in only a small amount of acetaldehyde. This necessitates a difficult separation of the product from the excess acetylene gas in order to recycle the latter for further reaction. In the air oxidation of ethyl alcohol process, although the reaction is much more complete, an excess of air is required which carries with it four parts of nitrogen to every part of oxygen, and results in a highly diluted gaseous product from which the acetaldehyde must be separated for recovery.

The proposed process utilizes a method whereby ethyl alcohol is converted into acetaldehyde by a removal of part of the hydrogen. This gives a product which is diluted only by an equal amount of the hydrogen by-product by volume and its recovery is comparatively simple. In addition the hydrogen by-product is valuable and can be utilized in the production of other chemicals needing hydrogen.

The operation of such a dehydrogenation process is much simpler than the present commercial processes employing an oxidation of ethyl alcohol or hydration of acetylene. Very small losses in yield occur in this process, resulting in a greater economy in terms of the starting material, and also includes lower processing costs and credits for the valuable hydrogen and ethyl acetate by-products.

Spearmint From Oranges

➤ CHEMISTS have now synthesized a spearmint flavor out of the peels of oranges and grapefruits.

The new product announced in Chicago to the American Chemical Society meeting by Dr. Carl Bordenca of the Southern Research Institute in Birmingham, Ala., will supplement and partially replace the natural material in chewing gum.

Natural spearmint oil has been variable in supply and quality in recent years. The new process will utilize a by-product of the citrus canning industry. The chemical synthesized is carvone, which is a compound also present to the extent of 65% in natural spearmint oil.

Dr. Rufus K. Allison and Dr. Philip H. Dirstine, of the same institute, joined Dr. Bordenca in the research.

Tartaric Acid Synthesis

➤ BAKING powder can now be made from wholly American materials, thanks to the commercial synthesis of tartaric acid. This ingredient has previously been made from deposits that form during the aging of French wine.

Prof. James M. Church of Columbia University's chemical engineering department told the American Chemical Society that tartaric acid should soon be made as cheaply from benzol, a coal-tar product, and hydrogen peroxide, as it can be recovered as a by-product of the European wine industry.

Chemical manufacture of tartaric acid was stimulated by the shortage of tartrates and the high prices of the wine industry product that followed World War II. Obtaining natural tartaric acid as a wine by-product is a slow and complicated process, involving much labor and handling of materials in southern France. Users of the chemical in the United States were affected by the fluctuations of the wine industry and tariff regulations.

Chemical manufacture of tartaric acid begins with maleic anhydride, which is made from coal-tar benzol. Combined with hydrogen peroxide in the presence of a little tungsten oxide as catalyst, a water solution of maleic anhydride gives pure tartaric acid that can be crystallized out simply.

Oxeye Against Insects

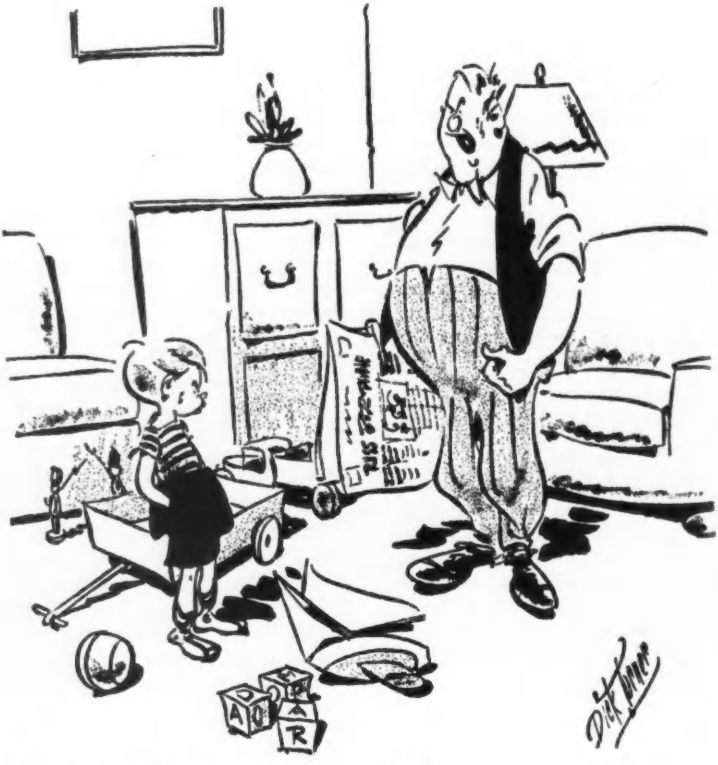
➤ OXEYE, a river bank weed, whose roots contain a powerful but short-lived insecticide may soon become an important new agricultural crop, Dr. Martin Jacobson of the U.S. Department of Agriculture predicts.

The insect poison, a thick, yellow oil, two and one-half times as powerful as pyrethrum, was isolated recently from a plant used by Mexican natives to combat household insects.

From the roots of Heliopsis scabra there has been isolated, in pure form, a compound closely related to the active constituent of the Mexican plant. It has been called "scabrin." The compound occurs in the dry plant to the extent of about two-tenths of one per cent, and is a thick yellow oil. Scabrin was found to be about two and one-half times as toxic as the pyrethrins to houseflies.

Oxeye occurs over most of the United States, growing on dry soils

and along river banks as a perennial weed from two to five feet tall. It is in the same family as the daisy, and is closely related to the sunflower. It is hoped that oxeye may be made a new agricultural crop in the near future.



➤ "FOR THE LAST TIME, *no, you can't have a chemistry set! You wanta grow up to be a spy?"*

Petroleum Products Studied For Insecticide Value

War Against Pests

➤ EVIDENCE that the petroleum industry is girding for all-out war against man's age-old insect foes was presented to the American Chemical Society's Chicago meeting in a series of papers by outstanding authorities in the field of insecticides.

The papers, which were given at a symposium on the "Agricultural Applications of Petroleum Products," covered a variety of topics ranging from an outline of the history of the use of petroleum sprays to the latest research results on proper selection of oils and most efficient means of application.

The symposium opened with a discussion of "Tree Spray Oils" by E. H. Smith of the New York State Agricultural Experiment Station, Geneva, N.Y. Pointing out that the use of petroleum oils as insecticides is not new—the earliest reference to such use dates back to 1787—Mr. Smith emphasized that there has been a steady growth in our knowledge of their insecticidal characteristics. The earlier oils of practically unknown composition have been gradually replaced by safer oils which are effective at lower doses than were heretofore thought possible.

The much publicized DDT has not been a panacea, it was made clear. Although the apple red bug has almost disappeared as a commercial pest in orchards following adoption of a DDT spray program, the European red mite, on the other hand, has actually become more prevalent as a result of the general use of DDT. Many of the other new insecticides also have severe disadvantages. Besides being costly, they frequently constitute an actual health hazard to both the operator and the consumer, and too often the insects have developed remarkable tolerance for the new insecticides. In other cases, the use of newer insecticides has been a factor in the outbreak of so-called minor pests.

Petroleum oils, on the other hand, possess few of these objectionable features, according to Mr. Smith, who said that in the matter of safety and economy they measure up well and no cases of the development of resistant strains have been reported. However, he continued, it would be most desirable if, through the joint efforts of petroleum chemist and insect toxicologist, specifications for the "ideal" hydrocarbon could be established.

The two succeeding papers, one by Dr. G. W. Pearce and Dr. P. J. Chapman of the New York State Agricultural Experiment Station, the other by Dr. L. A. Riehl and Dr. P. J. LaDue of the University of California Citrus Experiment Station, took up this thought. Under the general subject of "Insecticidal Properties of Hydrocarbon Composition" they outlined the findings of their respective stations to

date. Since about 1940, entomologists and chemists at the New York State Agricultural Experiment Station have been carrying on an intensive study of the insecticidal properties of petroleum oils as applied to deciduous fruit trees. It was soon realized that certain of the findings had world-wide application—about 25,000,000 gallons of petroleum oils are applied annually to fruit trees throughout the world for pest control—and that it would be desirable to form an active alliance with workers at the Citrus Experiment Station in California who over a period of a quarter century had made major contributions to this field.

The Geneva workers presented data to the Society extending earlier findings which indicated that hydrocarbons in which the carbon atoms are joined together in chains are more effective than the ring type. It was also disclosed that hydrocarbons having less than about 21 carbon atoms per molecule have little insecticidal value, whereas compounds in the range of 23 to 34 carbons are highly effective. The data thus provide a basis for defining chemically the ideal hydrocarbon composition for use as a horticultural insecticide.

The workers of the Riverside, California, Citrus Experiment Station supplemented the Geneva findings in a report on the insecticidal efficiency under laboratory conditions of various members of two series of narrow boiling fractions for adult female California red scale and eggs of the citrus red mite 24 hours old. Although excellent progress has been made in the use of natural enemies such as parasites and predators in control of certain important pests of citrus, control through the use of chemicals continues to be necessary for the production of the crop, and petroleum oils continue to be the most efficient insecticides per unit cost for most of the dominant citrus pests.

It was stated that correlations established at Riverside, between insecticidal efficiency and various properties of the fractions such as structural character, molecular weight and viscosity indicate that conventional spray oils used on citrus in California may contain appreciable amounts of hydrocarbons of low insecticidal activity, but that the efficiency of spray oils may be considerably improved by proper selection with respect to these characteristics.

An important element in the selection of spray oils, it was pointed out, is that they may cause damage to the host plant if used at excessive dosages. Fortunately, the results to date indicate that the most insecticidally effective types of oils are also the safest to plants. Moreover, since they are highly efficient insecticidally, they can be used at dosages considerably below those now commonly employed. In practice, this means that the ideal hydrocarbon composition will control the economically important oil-susceptible species at dosages of one-tenth to one-half of that required when using conventional spray oils now available on the market.

Industry, it was concluded, now has the problem of finding ways and means to manufacture hydrocarbon compositions approaching the ideal indicated by the current studies. It is expected that more efficient and safer

hydrocarbon oils for use as horticultural spray oils will result.

In a report by A. E. Griffiths and M. J. Janes of Socony-Vacuum Laboratories, Brooklyn, N.Y., it was brought out that light isoparaffinic fractions (paraffins with side chains) are relatively low in toxicity towards several plant species and show promise as insecticides for use alone or in combination with other insecticides. In field tests it was shown that some isoparaffinic fractions may be applied in concentrations up to 100 per cent without injury to leaves, buds or twigs. In comparison, highly refined paraffinic kerosene caused serious leaf injury at concentrations of 5 per cent and higher, while a somewhat heavier-bodied, conventional summer spray oil resulted in injury at 3 per cent or above. As a result of their studies it was proposed that the Acid Number test could serve as a safe measure of the phytotoxic characteristics of refined isoparaffinic fractions.

Discussing the use of petroleum oils in mosquito control, Dr. H. H. Stage of the United States Department of Agriculture corrected the common belief that oil kills mosquito larvae by suffocation. It has been thought that larvae are unable to thrust their breathing tubes through the oil on the water surface to get oxygen. Actually, the toxicity of petroleum oils as mosquito larvicides increases with their volatility; the lethal effects are produced by the penetration of the tracheal tissue by volatile gases from the oils. Mechanical suffocation may, of course, be brought about by actual contact with the heaviest and least volatile oils. It was noted that since DDT and other synthetic hydrocarbon insecticides have been available, the comparable volume of oils used in mosquito control work has dropped considerably. This is because the efficiency of the oil has been increased several times by the addition of these new toxicants.

With the increased use following World War II of DDT as an insecticide, the interest in solvents for this material has also increased. A paper by J. W. Arkis and G. W. Flint, both of the Research Department, Standard Oil Company (Indiana), stated that whereas straight chain hydrocarbons can not be used to obtain concentrated DDT solutions, ring type hydrocarbons and ketones, hydrocarbons with an oxygen bond, are good solvents for the insecticide, and a ring type, cyclic, hydrocarbon ketone makes for a more concentrated solution than the straight chain, paraffinic, ketone. The solubility of DDT in ketones decreases with increasing molecular weight.

The use of thermal oil fogs as insecticides and insecticide carriers was discussed by Dr. D. L. Collins, Acting State Entomolgist of New York. This development has become of increasing interest to entomologists and others concerned with insect control since the second World War, when thermal aerosols to a large extent came to supplement and then to supplant chemical aerosols as screening smokes to cover military operations. The use of petroleum derivatives as solvents for DDT as well as for smoke screen producers suggested the use of DDT oil solutions to produce fogs that would be lethal to insects such as mosquitoes and house flies. Effective con-

trol methods for certain specific insect problems were evolved, Dr. Collines stated, through the purposeful collaboration of engineers, mechanics, chemists, physicists, and entomologists.

Just as the type of bomb used by the Air Force is dictated by the target and the terrain, so the optimum size of particle in oil insecticide sprays varies according to conditions, as stated in a paper delivered by A. H. Yeomans of the United States Department of Agriculture, Bureau of Entomology and Plant Quarantine. Particle size of insecticidal sprays must be related to the ability of the spray to be transported and deposited, to possible foliage injury, to the efficiency of residues in killing insects, to whether the spray is for indoor or outdoor use, and to the time available for settling. Thus, in a large closed warehouse containing packaged food, the optimum particle size has been found to be between 1 and 5 microns in diameter (a micron is 39 millionths of an inch). If allowable settling time is short, however, the particle size must increase according to known laws for settling rates and deposit of particles on objects in moving air streams, as correlated with actual conditions. If the time of application were limited to about 15 minutes, the particle size for the same conditions would range from 15 to 30 microns.

The optimum particle size is also affected by the particular insect to be killed, Mr. Yeomans said. It takes, for instance, a larger particle to kill adult house flies (15 to 20 microns diameter) than it does to dispose of adult mosquitoes (10 to 15 microns diameter).

Geiger Counters Find Oil Pools

➤ Geiger and other radiation counters may soon be standard equipment for searching out new pools of oil.

The use of radiation detectors in hunting oil was discussed at the Oak Ridge meeting of the American Physical Society. Drs. Clark Goodman, Charles W. Tittle and Henry Faul developed this application while working at the Massachusetts Institute of Technology.

They found that the penetration of solid materials by neutrons and gamma rays gave an index of the structure and composition of the surrounding cased drill holes. Counters can be used to detect the radiation from formations near these holes.

They also found that when a portable neutron source was lowered into well casings, the neutrons caused gamma rays to be emitted from the surroundings. These rays can likewise be measured to indicate the structure of surrounding formations.

When measurements of the amount of radiation are made at the same time at several points along the axis of a drill hole near a porous formation, they can be used to tell whether the formation contains oil or water, either salt or fresh.

These measurements can also indicate the efficiency of other techniques now used to locate oil reservoirs. This use of radiation detectors should increase our knowledge of conditions under the earth's surface.

Carbohydrate Chemistry Today

Excerpt from an address, *Modern Developments in Carbohydrate Chemistry*, at the British Association for the Advancement of Science, Birmingham, England.

by PROF E. L. HIRST, F.R.S.

➤ WE MAY now consider briefly how these various methods are applied to the study of a typical polysaccharide. In the first place it is necessary to obtain the material in a pure state and we are at once confronted with a major difficulty. Only in very rare instances, such as cotton cellulose and some of the waxy varieties of starch, does nature provide an easily obtainable single polysaccharide in a state approaching chemical purity. Much more often do we encounter mixtures of several polysaccharides of closely related structure, as in the hemi-cellulose group, the pectins, mucilages and seaweed carbohydrates. In such circumstances it is essential to conduct the isolation and purification with the utmost caution and by methods which will preserve both the structure and the molecular size of the material which is to be examined. Once this has been achieved, analytical procedures are available by which the proportions of uronic acid, pentose and methyl pentose residues may be determined. After hydrolysis of the polysaccharide the liberated sugars can be identified and the proportions determined by chromatographic or other methods. Attempts to ascertain the shape and size of the molecule by physical methods may then be made. It is useful also to carry out oxidations with sodium or potassium periodate in order to ascertain whether formic acid, formaldehyde or acetaldehyde are liberated, and whether any of the sugar residues of the polysaccharide remain unattacked by the periodate. In this way much information concerning the mode of linkage of the sugar residues may be derived.

An effort to simplify the problem can then be made by taking advantage of the different rates of hydrolysis of the various sugar residues present in the molecule. In this way the more labile residues may be removed, leaving a resistant core which has a much simpler structure. Good examples of this are found amongst the gums and mucilages which often contain pentose residues which are readily removable on hydrolysis by dilute acid, leaving a polysaccharide consisting essentially of hexose and uronic acid residues. On further hydrolysis it often happens that a resistant acidic disaccharide unit is isolated, such as 6-β-*D*-glucuronosido-*D*-galatose from gum arabic and 2-β-*D*-glucuronosido-*D*-mannose from cherry gum. The structure of these aldobiuronic acids can be ascertained by the standard methods, and important evidence concerning the order and mode of junction of two of the residues thus becomes available. Similarly, by careful control of the conditions of hydrolysis it is sometimes possible to isolate a resist-

ant disaccharide or a trisaccharide. . .

Further information is sought by applying the methylation method both to the original polysaccharide and to the more resistant portion which remains after partial hydrolysis. By hydrolysis of the fully methylated derivatives two sets of partially methylated monosaccharides are obtained, the free hydroxyl groups in which denote the points of linkage in the polysaccharide. A comparison of the positions of the free hydroxyl groups in the hydrolysis products from the degraded polysaccharide with those in corresponding residues derived from the original polysaccharide then provides further evidence of the mode of linkage of the residues. By piecing together all these items of information the general structure of the repeating unit of the polymer becomes evident even if, as is usually the case, a unique structure cannot yet be assigned.

Such then are the methods available and it is proposed in conclusion to summarise briefly the position now reached in assigning structures in the main groups of polysaccharides. It is in this field that we encounter the greatest complexity and unfortunately the trend of recent results permits of few generalisations which would enable a comprehensive picture to be drawn. The widest diversity is found amongst polysaccharides of biological importance in regard to the number and nature of the sugar residues, their mode of linkage and the types of branched chain structure present in the molecule. . . .

In cellulose we have to deal with a macromolecule of collodial dimensions containing some 3,000 or more individual sugar residues. Many of the properties which are of the greatest importance in industry, such as the sensitivity to hydrolysis and to oxidation, appear to depend on a minute fraction of the total number of residues and for the detection of these centres it would be necessary for the chemist to deal with yields of a fraction of 1 per cent. It is indeed in the nature of a triumph for the organic chemist that he can already claim a knowledge of some 99.5 per cent. of the molecular structure, but the small remainder is of special importance in the behaviour of a macromolecule and the search continues, and it is not yet established whether the source of the instability is an inherent property of molecules above some limiting size or whether linkages of another type recurring at long distances apart in the chain of glucose residues are responsible.

A similar and as yet unexplained instability towards hydrolysis is encountered also in another of the glucose polysaccharides which have been intensively studied. This is the amylopectin component of the starch granule. Until a few years ago it was uncertain whether the carbohydrate portion of the granule was a single polysaccharide or a mixture but since 1940 it has become clear (Meyer; Schoch; Kerr; Peat) that in general two components are present in intimate mixture. One of these, designated amylose, is structurally very like cellulose in being composed of unbranched chains of 1 : 4-linked glucopyranose residues, with an *a*-glucosidic link in place of the *β*-junction found in cellulose.

The length of the chain is from 100 to 500 glucose residues depending on the variety of starch. The amylopectin component is usually present in greater proportion in the starch granule and in the so-called waxy varieties of starch, and amylose content may be less than 1 per cent. The molecule of amylopectin is unusually large and may contain several thousand *a*-glucose residues. As in amylose these are linked together through C_1 and C_4 but in striking contrast the molecule is now highly branched and the molecular structure comprises a large number of short units constituted like amylose but containing only about 20 glucose residues. These short chains are joined to each other by a glucosidic link between the reducing end group of one unit and position C_6 of one of the central glucose residues in another. Much of the detail of this picture remains to be filled in and it is possible that about 1 in 100 of the glucosidic links are of a different chemical type. . . .

The polysaccharides we have considered so far provide problems of quite sufficient difficulty, but they are to be regarded as simple in that only one type of sugar residue had to be dealt with. Much greater complexity is encountered when the molecule contains two or more kinds of residue. A great many polysaccharides of biological and industrial importance come within this category and the already formidable list is growing as investigations proceed into the nature of bacterial polysaccharides, hemicelluloses, plant gums and mucilages. Knowledge of the structure of substances such as the pneumococcal polysaccharides and hyaluronic acid is obviously important in medicine, and later on in this discussion Prof. M. Stacey, F.R.S., will deal with the chemistry of the bacterial polysaccharides and the fascinating biochemical problems involved in this field. In industry, only empirical data are available for controlling the use of such materials as gum arabic, gum tragacanth and gum guar, which are used on a large scale in textile finishing, paper making and other operations. In this field, however, structural work is only in the initial stages and it seems likely that for the full solution of the problems it will be necessary to develop new methods. Nevertheless, as the result of work carried out during the past dozen years, preliminary knowledge of the general structure of several gums and mucilages has been gained. These include gum arabic, gum tragacanth, gums from the damson and cherry trees, grapefruit and lemon gums and mucilages from numerous plant seeds and seaweeds and from the bark of the tree *Ulmus fulva*. They contain a bewildering variety of sugar residues united in almost all of the available positions. In so far as any generalisation is yet possible it may be said that there is a tendency for the gums to contain a stable backbone of firmly linked galactose residues to which are attached various side chains containing uronic acid and pentose residues.

Natives of the Aleutian islands killed whales by poisoning; a whale hunter lunged a lance smeared with poison from aconite root into the animal which later died and drifted ashore.

Single Spectrum Line
Could Replace Meter Bar

Mercury Gives Length Standard

➤ A UNIT of length will make possible measurements of distance with an accuracy of at least one part in a million million.

This unit, which may be adopted by the National Bureau of Standards as a result of the stable isotope separation program of the Atomic Energy Commission, is the characteristic wave length of the single spectrum line of an enriched form of mercury. Dr. C. P. Keim, director of the Isotope Research and Production Division of the Union Carbide and Carbon Corporation at Oak Ridge, Tenn. reported this possibility to the joint meeting of the American Chemical Society's Georgia Section and the Southern Association of Science and Industry at Atlanta.

There are seven natural stable isotopes of mercury. They complicate its spectrum when mercury arc lamps are examined spectroscopically. However, should the isotopes of odd atomic weight, Mercury 199 and Mercury 201, be removed, the spectroscopic picture would be greatly simplified.

The stable isotope separation program went further than this, however, and produced enriched natural Mercury 202 of better than 98 per cent purity. This gives a single spectral line, the length of which is always and everywhere the same. The same effect results from the use of Mercury 198, which is made from gold in a nuclear reactor—in fact, the spectral line of Hg 198 has been proposed by Dr. William F. Meggers of the Bureau of Standards as the unit from which all measurement should be standardized instead of the standard platinum-iridium meter bar. The choice between the two mercury isotopes would rest on their relative availability.

The stable isotope separation program is useful in many other fields—the design of neutron reactors, the vulcanization of rubber, medical research and fundamental chemistry, Dr. Keim reported.

In atomic pile operation, for instance, the reactor is "dampened," which involves absorption of neutrons by inserting rods of cadmium into the pile. As neutrons are absorbed the atomic "fires" are lessened.

Cadmium has eight stable isotopes, all of which are very low absorbers of neutrons except cadmium 113. The ability of an element to absorb neutrons is measured by its neutron cross section value expressed in a unit called a barn. If all other cadmium isotopes were used, omitting cadmium 113, the cross-section would be only a few barns, whereas when cadmium 113 is used alone the cross section is 24,000 barns. Dr. Keim said that in the future we shall not only use alloys of elements to gain the proper chemical and physical properties, but we will use alloys of isotopes to gain the needed nuclear properties.

Starch

by Burton L. Hawk

➤ As anyone who has ever been on a reducing diet will verify, starch is present in a large variety of foods. It is found as a reserve material in many different plants. Thus we find it abundantly in tubers, roots, nuts, grains, potatoes, chestnuts, and acorns. So, if you are trying to lose weight, avoid eating roots, potatoes, grains, chestnuts and acorns.

For commercial use, starch is usually made from Indian corn (maize) which contains 55% starch. The corn is softened in warm water, then is passed through a mill to break it up. Next it is forced through a germ separator. The remaining semi-fluid mass is then ground and passed through sieves. The starch and gluten suspension which passes through is allowed to settle in troughs, where the lighter gluten rises to the top and can be drawn off. Finally, the starch remaining is washed and dried.

Preparation

You can prepare starch in the home laboratory more easily from potatoes than from corn.

First peel the potato, which is the most difficult part of the procedure. Next, using a grater, grate the potato to a fine pulp. Mix the pulp thoroughly with water and filter through cheese-cloth. The filtered mixture consists primarily of starch suspended in water. Allow the starch to settle, carefully pour off the water, spread out on a glass plate and allow to dry.

For the following experiments, a colloidal starch solution is required. Prepare it by mixing 2 gr. of starch, either that prepared above or regular corn starch, with about 25 cc. of water in a mortar. Grind with the pestle until a smooth suspension is obtained —free from lumps. Next pour this mixture slowly, with stirring, into 235 cc. of *boiling* water. After all is added, stir for a few minutes, then allow the solution to cool thoroughly.

Test

Of course, no discussion on starch is complete without the famous iodine test. So just to prove to our own satisfaction that the potato contains starch, we will perform the test.

Dissolve a few crystals of iodine in 10 cc. of potassium iodide solution. Add a few drops of this mixture to a portion of the starch solution. Immediately a dark blue color is formed, indicating the presence of starch. This is a very delicate test, as can be demonstrated by allowing just a drop or two of starch solution to fall into a large breaker containing about 500 cc. of water. Add a drop of iodine solution, and observe if the blue color is formed.

Hydrolysis

Starch is *hydrolzed* to glucose by mineral acids, or to maltose by the enzyme, diastase.

Add 3 or 4 drops of hydrochloric acid to 25 cc. of starch solution. Heat gently for fifteen or twenty minutes, preferably in a water bath. Allow the

solution to cool, then neutralize with dilute sodium hydroxide solution. Separate the neutral solution into two parts. To one, add a few drops of iodine solution. The blue color is not formed, indicating starch is no longer present. To the other, add equal parts of Fehling's Solution, No. 1 and 2, or a small quantity of Benedict's Solution (see below). Heat to boiling, then let stand. The Fehling's solution will be reduced and a yellowish-red precipitate of cuprous oxide is formed. This test indicates the presence of a sugar which in this instance is glucose.

As soon as starchy foods are placed in the mouth, partial digestion is begun by the saliva. Digestion in this case consists of converting the starch into sugars which the body can use.

Collect 1 cc. of saliva in a test tube, and mix it thoroughly with 25 cc. of starch solution. Bring the solution to a temperature of 40° and maintain it for fifteen minutes. Then test with Fehling's or Benedict's solution. The yellowish-brown precipitate will show that the enzymes present in the saliva have already converted part of the starch into sugar.

Sugar Test Solutions

Fehling's Solution No. 1—Dissolve 1.5 g. copper sulfate in 50 cc. water.

Fehling's Solution No. 2—Dissolve 8.5 g. sodium potassium tartrate (Rochelle salt) in 10 cc. warm water. Add a solution of 2.5 g. sodium hydroxide in 10 cc. water. Finally dilute the mixture with 30 cc. water.

Keep the two solutions separate until ready for use. Then mix together equal quantities of each and add to the solution to be tested.

Benedict's Solution—Dissolve 10 g. of sodium citrate and 6 g. of anhydrous sodium carbonate in 50 cc. of hot water. Add slowly, stirring constantly, a solution of 1 g. copper sulfate in 10 cc. water. The resultant solution should be perfectly clear. If it is not, then filter.

Benedict's solution is used as is. No mixing is necessary, and it will not deteriorate on standing.

Filbert Enzymes Used in Cheese Making

➤"It's the nuts" could be said of a new American cheese of superior flavor that was reported to the American Chemical Society at Chicago by four Oregon State College chemists.

Substances that help to digest protein—called proteolytic enzymes—can now be obtained from filbert nuts. They are used in cheddar cheese making. Tested for their effect on processing pasteurized milk into cheese, the filbert enzymes gave a product of better flavor which was described as mild and clean. The ripening time of the cheese was also substantially shortened, which reduces the expense of storage room.

Filberts are already a surplus crop in Oregon and many young filbert orchards will produce constantly increasing yields. The research on filbert extracts was done by Husain A. B. Parpia, Roy W. Stein, Thomas B. Niven and Ernest H. Wiegand.

New Developments in War on Disease in Many Laboratories

Chemical Facets of Medicine

The research cooperation between chemistry and medicine continues in many fields and in many institutions.

Common Factor of Diseases

➤ APPEARANCE of a purple color in a test sample of your blood can indicate whether you should be examined for cancer, tuberculosis, rheumatic fever or rheumatoid arthritis.

The test may give even more information about the fundamental difference between sickness and health, according to Dr. Washington Ayala Bonilla of the University of Montevideo, Uruguay, and Dr. Eugene L. Hess of Northwestern University who are working at the Rheumatic Fever Research Institute at Northwestern.

The purple color results when the alpha globulin fraction of your blood contains a particular kind of sugar in combination with mucoprotein. When a coal-tar product known to chemists as diphenylamine is mixed with such blood, the color warns that the sugar fructose and an abnormally large amount of mucoprotein are present.

Such a condition is present in the blood of cancer and tuberculosis patients. It has now been found in those suffering from rheumatic fever and rheumatoid arthritis as well. Drs. Bonilla and Hess believe the condition may be characteristic of other diseases as well, and that they may have found one of the fundamental ways in which the body chemistry is altered in disease.

Other sugars of similar structure give a similar color test, and other fluids of the body are found to contain materials similar to the blood's alpha globulin in this test. The researchers hope to learn from this work more about the chemical reactions that go wrong when disease is present.

ACTH For Burns

➤ ONE of the wonder drugs relieving arthritis, ACTH, promises to become a life-saver for badly burned soldiers and civilians who otherwise would die.

The American Chemical Society, discussing the chemical structure of this drug extracted from pituitary glands, heard of a case in Phoenix, Ariz., of a man badly third-degree-burned in an oil fire who was given ACTH with complete recovery after skin grafts. Without ACTH the man would undoubtedly have died, but the anti-arthritis drug prevented fluid loss, toxemia and muscle damage usual in such severe burns.

Armed service experts heard of the case, which was handled by Dr. Maurice J. Whitelaw, and observed it. As a consequence those handling ACTH production expect that it will be used medically at the fighting front. This may even slow down the application of the drug for treating arthritis and other diseases among civilians.

One of the newer uses of ACTH has been to combat acute alcoholism.

Dr. D. F. Waugh of the Massachusetts Institute of Technology reported that the weight of the ACTH molecule is much smaller than previously supposed, 1,000 to 1,300 times the weight of the hydrogen atom. This means that the structure of ACTH is considerably simpler, containing only half a dozen different amino acids as building blocks. This gives the chemists new hope that eventually they will be able to manufacture ACTH artificially rather than obtain it from the pituitary glands of hogs, which are in short supply.

Anti-Artery Hardening

➤ PREVENTION of arteriosclerosis, or hardening of the arteries—a frequent cause of heart disease in man—may be possible through the use of a vitamin-like substance called inositol, a young woman biochemist, Miss Stephanie J. Ilka, from St. Luke's Hospital, New York, reported.

Experiments on animals indicate that inositol, a common constituent of plant and animal tissue called "muscle sugar" because of its sweet taste, can effectively reduce the level of cholesterol in the blood, Miss Ilka stated. Cholesterol is a fatty compound now widely regarded as the arch villain among arteriosclerosis causes.

Specifically, Miss Ilka said, the experiments showed that laboratory animals fed both cholesterol and inositol showed a far smaller increase in cholesterol in the blood serum than did animals to which cholesterol alone was given.

The work so far has been done only on rabbits, and there is no guaranty that similar results will be obtained on human beings, but it seems reasonable to assume that any substance which prevents the rise of cholesterol in the blood of rabbits might do the same in human beings.

Cholesterol is a fatty substance occurring naturally in the body. It is taken into the body as an ingredient in certain foods, such as milk, eggs, and cheese. When, somewhere along the line, the complicated process of metabolism—or utilization of food to provide energy—gets out of gear, an excessive amount of cholesterol accumulates in the blood. It is thought that possibly the fatty material is deposited in little globules along the walls of the arteries. After this has gone on for a time, the walls become roughened and the passageway for the blood is greatly reduced in size, so that the heart has to work harder to push the blood through.

Just what part inositol may play in cholestorol metabolism is not clear, interest in this particular function of inositol being relatively new. Inositol itself was discovered in animal tissues about a hundred years ago. It also has been found to exist widely in seeds and other plant materials as part of a compound called phytin. The corn kernel is a particularly rich source, and inositol is made commercially from corn products as a white, crystalline powder, soluble in water. Inositol is believed to be important in nutrition, and is sometimes classed as a member of vitamin B complex.

Potent Fluorine Antiseptics

➤ THE UNRULY gas fluorine, tamed by wartime research, has provided science with antiseptics as much as a thousand times more powerful than carbolic acid but without its harmful

effects, Dr. Earl T. McBee and Roy L. Milde reported.

The ultra-violent chemical is also improving fire extinguishers, lubricating oils and a host of other modern products.

The presence of fluorine in certain compounds used as antiseptics greatly improves their germicidal potency. Materials called quaternary ammonium salts have long been used as antiseptics in the treatment of skin infections.

The quaternary ammonium salts are powerful antiseptics, and by introducing fluorine into these compounds, the antiseptic potency is considerably increased.

For comparison, carbolic acid is used as the standard agent by which other germicidal agents are measured. Hexylresorcinol, a common antiseptic, is 7.0 times more effective than carbolic acid against the bacteria *staphylcoccus aureüs*. That the fluorinated quaternary ammonium salts varied from 297 to 1,100 times more effective than carbolic acid illustrates their potency. Also, the skin irritation caused by carbolic acid is considerably reduced using these materials.

A solution of a fluorinated quaternary ammonium salt in water causes the water to wet textiles more rapidly and efficiently. Thus, these germicidal agents behave much like common detergents.

Research is being conducted on the preparation of a host of materials containing fluorine. Fluorinated compounds are being studied as dielectric fluids for capacitors and transformers, additives for hydraulic fluids and lubricating oils, fire extinguishing agents, and many other uses, some of which have assumed greater importance in view of the present needs of the armed services.

Less Serum for Diagnosis

➤ Diagnosis and treatment of certain children's diseases will be aided by an easier and faster method of measuring fatty substances in the blood serum.

This is the first method of determining serum fat which has been developed for use on small amounts of blood such as can be obtained from infants and children, according to a report to the American Chemical Society by Elizabeth Kaiser, and Dr. B. M. Kagan, of the Department of Pediatric Research, Michael Reese Hospital, Chicago. The new technique requires less than four drops of serum or two-tenths of a cubic centimeter. Heretofore the smallest sample which could be used for assay was two cubic centimeters.

This procedure enables the investigator to obtain results with these small amounts which are as accurate as those formerly obtained by using larger amounts of blood. In addition, the procedure is easier and more rapid than older methods.

Streptomycin From Japan

➤ Isolation of a new form of the antibiotic drug streptomycin from a Japanese soil was announced to the American Chemical Society by Dr. Frank H. Stodola of the United States Department of Agriculture's Northern Regional Research Laboratory, Peoria, Ill.

Although streptomycin has found considerable use, its value in the treatment of chronic diseases such as tuberculosis is limited by its toxicity and

the ready development of bacterial resistance to it.

Obtained from a new mold known as *Streptomyces griseocarneus,* the new streptomycin, christened hydroxystreptomycin, differs from the type now in medical use only in having an extra oxygen atom in its molecular structure.

Attraction in Virus Attack

➤ A THEORY that electrical attraction governs the first step in the attack of disease-causing viruses on body cells was reported to the Chicago meeting of the American Chemical Society.

Blocking this attraction would be the way to give immunity to the virus, according to this theory.

The blocking is possible, laboratory experiments confirmed by radioactive tracer studies show, Prof. Theodore T. Puck of the University of Colorado Medical Center, Denver, finds.

Viruses are the causes of a wide range of diseases from poliomyelitis to the common cold. Prof. Puck's studies were made with a virus that does not cause human disease but is representative of viruses in general and is suitable for laboratory experiments.

The virus attacks the cell by a two-step process, Prof. Puck found. In the first step attachment to the cell results from a purely electrical attachment governed by charged metallic atoms, or ions, normally present in the cell's environment. Introducing certain other metallic ions, not ordinarily present, blocks this attraction.

In this second phase of the attack, the virus becomes a part of the cell. This step cannot be reversed. The length of the period between the first and second steps, during which the ionic counter-attack must be made, is not yet known.

Resins to End Salt-Free Diets?

➤ ION EXCHANGE resins may put an end to the monotonous no-salt diet which many patients with dropsy from heart disease and other ailments must now follow.

Good results with these chemicals in both animal experiments and trials on human patients were reported to the American Chemical Society by research groups from the Sterling Winthrop Research Institute and from Smith, Kline and French Laboratories.

Dropsy, or edema as doctors term it, is an accumulation of body fluid. It occurs in cases of congestive heart failure, cirrhosis of the liver and some cases of high blood pressure. The fluid accumulates because the body is unable to get rid of enough sodium, such as is contained in common table salt.

Drinking large amounts of water to wash out the salt and at the same time reducing drastically the intake of salt have been measures used to overcome the dropsy.

Using the principle developed during the last war to remove salt from sea water to make it drinkable, the two groups of scientists have developed special ion exchange resins to remove salt from the patient's body.

In order to avoid robbing the body of potassium as the sodium is being removed, a combination of ammonium and potassium forms of the resin was adopted.

The cation exchange resins used to remove salt in dropsy cases should

not be confused, it was pointed out, with anion exchange resins used in treating stomach ulcers. The latter type work by "binding" the acid in the stomach.

Radioactive Adrenaline

➤ ADRENALINE, gland chemical famous as a life-saving stimulant in many a dramatic case, has now been made with radioactive carbon from the Atomic Energy Commission's plant at Oak Ridge, Tenn.

Synthesis of the radioactively-tagged compound was reported by Dr. Richard W. Schayer of the Rheumatic Fever Research Institute, Northwestern University Medical School.

Adrenaline is converted into at least five substances in the body, studies with radioactive form suggest. From his findings so far, Dr. Schayer described the fate of adrenaline injected into the body as follows:

"Adrenaline is removed from the blood by the body tissues, where it is converted into one or more new substances differing in properties from the original adrenaline. The new substances are then released from the tissues back into the blood stream, from which they are picked up by the liver and kidney for possible further change and excretion.

"The identity of the substance or substances found in high concentration in the blood is of interest and will be investigated in later studies."

Moderate Cost Serums

➤ SPECIFIC serums for treating many diseases may be provided at moderate cost through the use of an improved method of separating blood components. The method employs ion-exchange resins according to Dr. Allen F. Reid and Miss Frances Jones of Baylor University, Dallas, Tex.

Two medically important protein components of blood plasma are the immune serum globulins and serum albumin. The immune serum globulins are the active ingredients of measles protection shots, and mumps protection shots, containing antibodies to many of the germs the human body has to combat.

Serum albumin helps to maintain the blood pressure and, therefore, proper circulation of the blood. When this circulation is impaired, as in the case of loss of blood and extreme emotional upset, "shock" often results. This condition is alleviated by the injection of serum albumin. The separation of this component from normal plasma is thus important.

The immune serum globulins are held in solution in the blood plasma by salts. If these salts are removed, the globulins will precipitate out of solution leaving the serum albumin unharmed in solution. These precipitated globulins may then be redissolved and used in appropriate manner by physicians. The albumin may be sterilized, concentrated and used for the emergency treatment of shock and other specific demands.

Heretofore blood plasma proteins have been separated by the successive precipitation of the globulins and albumin by treatment with alcohol at very low temperature. The new method would remove the salts from the serum solution by using ion exchange resins. These ion exchange resins are the materials which are used in softening or desalting water in both in-

dustrial and domestic uses. However, in this operation, they remove the salts from the serum rather than from water.

Salt removal by ion exchange resins has certain advantages over previously used methods. The operation can be carried out at ordinary room temperatures and does not require the low temperature equipment and impose the difficult operating conditions which are necessary in the cold alcohol methods. For another thing, the antibodies for the protection of the individual from disease are more stable when separated this way than when prepared by the cold alcohol procedure. Another advantage of this method is that it makes available to the ordinary laboratory worker a method of studying the individual fractions of the blood proteins.

Lopsided Atoms for Catalytic Action

➤ SOME of the mystery of catalytic action has been solved by Dr. W. A. Weyl of the department of mineral technology of Pennsylvania State College.

Catalysts speed up chemical processes by their mere presence, without taking any part in the reaction, and are widely used in oil refining and other industries.

Electrical fields inside the atoms, which pull and distort the shape of atoms near the surface, and so make them act in an unusual way, are responsible for the catalytic effect, according to Dr. Weyl's interpretation. Some of the unusual colors of crystals and certain trade secret processes can be explained by the same action of warping and crowding of surface atoms.

One such is the process of swabbing the glass in mirror manufacture with a solution of a tin salt, which is thoroughly washed off before the silver is applied. According to Dr. Weyl's theory, enough deformed tin atoms cling to the surface of the glass to present on their free side a metallic film to which the silver will become attached.

The new theory also accounts for the so-called poisoning of catalysts by certain types of compounds. Poor materials can be improved and good ones made better for catalytic purposes as the theory of their action becomes better known. Dr. Weyl presented his theory at a recent meeting of the New York Academy of Sciences. His work is sponsored by the Material Branch of the Office of Naval Research.

Magnesium first came into commercial production in Germany in 1896; a 90% magnesium alloy with aluminum, zinc and manganese, 40% lighter than aluminum, was put on the market in 1909 under the name of "elecktron."

Untreated standing telegraph poles showing signs of decay at the ground line can have their lives much lengthened by an application of sodium fluoride a foot below the soil surface and a mixture of creosote and coal tar extending upward three feet.

Fuel Cell Converting Chemical Energy Directly to Electricity Is Problem

Chemical to Electrical Energy

by Dr. H. J. T. Ellingham

Secretary, Royal Institute of Chemistry, London

➤ A "voltaic cell" may be regarded as a device for converting the "free energy" of a process into electrical energy. In principle, almost any type of spontaneously occurring chemical reaction is capable of being "harnessed" as a voltaic cell and the "chemical energy" of the reaction thus rendered convertible to electrical energy in the discharge of the cell.

In practice, only a few types of chemical reaction have been effectively harnessed in this way—as "primary cells." Indeed, the operation of practically all established forms of primary cell is based on the oxidation of a metal (generally zinc) to one or other of its compounds. Although the efficiency of conversion of chemical energy to electrical energy in the discharge of such cells may be high, the yield of electrical energy is normally very small in relation to the total amount of energy in various forms that has had to be expended in producing the metal by reduction of compounds derived from its ores. In the ordinary applications of primary cells, however, the over-all energy efficiency, or even the efficiency of the discharge process itself, may be of less significance than other characteristics, such as portability and the ability to deliver a specified current for limited periods at intervals during a long effective "life."

Read before the meeting of the British Association for the Advancement of Science, Birmingham, Sept. 5, 1950.

If an efficient primary cell could be developed to harness the oxidation of carbon, however, such a cell might furnish an alternative means for the large-scale generation of electrical energy from coal. The possibility is attractive because the chemical energy of the fuel (plus oxygen) would then be convertible to electrical energy in a single process with no upper limit of efficiency set by the second law of thermodynamics; whereas the established system of generation involves three energy conversions — chemical energy to heat, heat to mechanical energy, mechanical energy to electrical energy—and the second of these (the heat engine stage) has an efficiency which is strictly limited in relation to the temperatures between which it can be economically operated. On a purely energy basis, the scope for a "fuel cell" is indicated by the fact that even in the best modern power-station practice the over-all energy efficiency based on coal is only about 30 per cent.

Even if it proved impracticable to harness efficiently as a primary cell the direct oxidation of a carbonaceous fuel (coal or coke), there might still be scope for an "indirect fuel cell" operating on the oxidation of a material that can be produced from such fuels without undue loss of available chem-

ical energy. Carbon monoxide, hydrogen and certain metals may be considered in this category of "secondary fuels." The data below show the maximum electrical energy in kwh obtainable at 25°, 500° and 1000° C. by the electrochemical oxidation of 1 kg of carbon and of equivalent quantities of the specified secondary fuels (assuming that in the production of hydrogen or the metals the carbon is completely oxidised to CO_2).

The figure for oxidation of carbon to CO_2 is practically independent of temperature and corresponds almost exactly with the ordinary heat of combustion; it thus affords a useful basis of comparison. At higher temperatures, however, the equilibrium $C + CO_2 \rightleftharpoons 2CO$ moves increasingly in favour of CO and, in so far as the product of the cell reaction is CO, the maximum electrical energy obtainable will tend towards the lower figure for reaction (1b). The balance of the energy remains available, however, in the CO and represents at least a source of heat, if not of electrical energy through the operation of a separate cell for reaction (2). This latter cell reaction, considered separately (i.e. as being supplied with CO produced by non-electrochemical means), is not however, a very favourable source of electrical energy, for even with operation of the cell at 500° C over 45 per cent. of the chemical energy associated with the original carbon will already have been dissipated as heat in the exothermic "producer gas" reaction.

On the other hand, the figures quoted for cell reactions (3) and (4) give an unduly favourable impression. The reactions whereby hydrogen or the "baser" metals are produced by reduction of their oxides with carbon are endothermic and unless they are linked with some other process evolving heat, additional fuel will have to be burnt to supply this heat. If allowance is made for this additional fuel as carbon, the maximum electrical energy obtainable from the subsequent cell-reactions (3), (4a) or (4b) per kg of *total* carbon supplied is correspondingly less, but at 25° C still does not lie more than 10 per cent. below the figure (97 kwh) for the direct oxidation of carbon itself; thus indicating that most of the chemical energy of the whole of the carbon used in the reduction process would be transferred to the secondary fuel if there were no heat or material losses. The extent to which the energy transfer is not quite complete even under

Energy From Electrochemical Oxidation of Carbon

Cell reaction	Maximum electrical energy obtainable kwh per kg of carbon 25° C	500° C	1000° C
(1a) $C + O_2 = CO_2$	(97)	97	(97)
(1b) $C + \frac{1}{2}O_2 = CO$	(33.5)	(44)	55
(2) $CO + \frac{1}{2}O_2 = CO_2$	(63.5)	53	42
(3) $2H_2 + O_2 = 2H_2O$ (g)	114	101	86
(4a) $Sn + O_2 = SnO_2$	126	130	76
(4b) $2Zn + O_2 = 2ZnO$	156	134	....

ideal conditions depends on differences between values of the available chemical energy (—ΔG) and the corresponding ordinary heat of reaction (—ΔH) and will increase with rise in temperatures as the two quantities diverge.

Where the reaction for the production of the secondary fuel has to be conducted at a relatively high temperature, the carbon will be oxidised at least in part to CO instead of CO_2 and available chemical energy will be correspondingly divided between the CO and the secondary fuel. The electrical energy obtainable from the latter will then be less (only half if only CO were formed), though here again the possibility of utilising separately the chemical energy of the CO is not excluded. Hydrogen and CO might even be electrochemically oxidised together in a single cell, but, for a metal and CO, separate cells would certainly be required if the chemical energy of both were to be recovered as electrical energy—a complication which it is desirable to avoid. For this reason metals such as tin or lead which can be obtained by carbon reduction at relatively low temperatures would be preferred to higher melting metals or those with much greater affinity for oxygen. Metals such as aluminum and magnesium which cannot be readily produced by carbon reduction of their oxides and are normally obtained by electrolysis (consuming electrical energy) are clearly ruled out. In any event, the higher the temperature of the reduction process the greater is the difficulty of keeping down heat losses, and, where a distillation operation is involved (as for zinc), heat and material losses would almost certainly bring down the over-all efficiency of generation of electrical energy to an uneconomic level.

From these considerations, it appears that the best prospects for a satisfactory fuel cell lie in the harnessing of reactions (1) or (3), or of an example of (4) such as (4a) involving an easily fusible metal whose oxide can be reduced with carbon at a relatively low temperature; reaction (2) provides another but less attractive possibility. Voltaic cells based on such reactions—especially (1), (2) and (3) — have been investigated, notably by E. Baur and his collaborators in Germany. Less attention has been given in this connection to the possible utilisation of reactions such as 4(a), the advantages of which have been stressed by E. K. Rideal.

Experimental Fuel Cells

In order to harness any chemical reaction as a voltaic cell the reacting substances must be kept apart from one another and employed as, or fed continuously to, two independent electrodes (consisting of conductors of the electronic class) between which there is conducting path including one or more electrolytes (conductors of the electroyltic class). For a fuel cell, therefore, the general form is—

$$\underset{-}{\text{fuel}} \mid \text{electrolyte} \mid \underset{+}{\text{oxygen}}$$

The oxygen would preferably be supplied as air to avoid the cost of separation; the electrical energy obtainable per kg of carbon is thereby decreased by less than 0.4 kwh even at 1000° C. During the discharge of such a cell, oxygen ionises at the positive electrode (cathode) yielding oxygen

ions or some other type of oxygenated ions (hydroxyl ions in aqueous solutions), while at the anode *either* the fuel substance ionises (hydrogen or the metals yielding the corresponding positive ions) *or* the oxygen or oxygenated ions in the electrolyte are discharged forming nascent oxygen which then reacts at the anode surface with the fuel substance. In either case the net chemical result for the cell as a whole is the oxidation of the fuel and the E.M.F. of the cell at any temperature is directly proportional to the free energy (chemical energy) per g.-equivalent of chemical change at that temperature.

Neither carbon nor carbon monoxide furnish corresponding ions, and their employment in a fuel cell therefore depends on their being oxidised anodically by nascent oxygen—a reaction which does not proceed at a reasonable rate except at elevated temperatures. On the other hand, the metals ionise readily even at ordinary temperatures, and hydrogen adsorbed on the surface of suitable metals (e.g. plantinum or nickel) will do likewise. Such electrode systems could therefore be used in cells with aqueous electrolytes. Unfortunately, oxygen does not furnish a reversible electrode system under these conditions, and although it ionises at the surface of suitable metals (e.g. nickel), the rate at which it does so at ordinary temperatures limits the effectiveness of fuel cells with aqueous electrolytes.

Much can be done to increase rates of ionisation and of other electrode reactions at ordinary temperature by the use of finely divided metals, either as surface coatings (e.g. platinised platinum) or disseminated through or constituting the body of a "diffusion electrode": e.g. finely divided platinum in carbon—Schmid's hydrogen diffusion electrode; electrodes of porous nickel—being investigated as hydrogen and oxygen diffusion electrodes under the auspices of the British Electrical and Allied Industries Research Association. Raising the temperature is of course beneficial through increasing reaction rates, but, for operation above the boiling point of solutions used as electrolytes, pressures greater than atmospheric become necessary. The free energy of the cell reaction is raised slightly by increasing the pressure (by 1 kwh per kg of carbon by raising the pressure to 50 atm. at 200° C), but against this must be set the cost of the energy used in compressing the gases supplied to the cell. Moreover, the highly catalytic electrode surfaces that would no doubt still be needed at this moderately elevated temperature are likely to be very susceptible to poisoning by impurities in the gases, and hydrogen obtained by the water-gas reaction would presumably have to be rigorously purified (at appreciable cost) in order to maintain the operation of the cell at high efficiency.

With all the electrode reactions in which a gaseous substance is consumed at a satisfactorily high rate, the general problem is to maintain an adequate concentration of that substance on or in the surface layers of the electrode where it is being consumed, and at the same time to maintain effective contact between the electrode surface and the electrolyte. With increasing rate of consumption of the

gaseous substance per unit area of electrode surface (i.e. with increasing current density taken from the cell) the effective concentration (pressure) of the substance that can be maintained at that surface under given conditions will tend to fall, and this fall may eventually become catastrophic as the maximum rate of access of the gas to the electrode surface under those conditions is approached. Any fall in effective concentration will be accompanied by a change in potential of the electrode—that of a positive electrode becoming less positive, that of a negative electrode less negative—and the working voltage of the cell, and hence the yield of electrical energy, will decrease as a result of this "polarisation." There is scope for improvement in electrode design, particularly perhaps in the development of new types of diffusion electrodes, for raising the current density that can be taken from a gas electrode without serious polarisation. Attempts have been made, however, to avoid "gas polarisation" altogether by adopting a simple oxidation-reduction system, such as ceric-cerous salt solutions, at both electrodes and maintaining the two halves of the solution (which must be separated by a diaphragm) in relatively oxidised and reduced conditions by passing air through the one and the fuel gas through the other. Such schemes present problems of their own, but the function of the cerium as an "oxygen carrier" serves to illustrate the general nature of fuel cells as "oxygen concentration cells"; the oxygen pressure is kept near to 1 atm. at one electrode by the supply of oxygen (or to 0.21 atm. by air) and down to a very low value at the other electrode by the fuel substance.

The fact that raising the temperature increases rates of reaction and diffusion, makes the prospects of fuel cells with molten salt electrolytes (at temperatures of 500° C and upwards) seem generally attractive. Higher current densities should be possible without serious polarisation and there should be no need to depend on the maintenance of highly catalytic surfaces, sensitive to poisoning. Moreover, conductivities of molten salts being generally somewhat greater than those of aqueous solutions, losses due to internal resistance may be reduced. On the other hand, the maximum electrical energy obtainable from most reactions falls off appreciably with rise in temperature (see table above). Also, steps must be taken to prevent undue heat losses (e.g. by using outgoing gases to pre-heat those entering the cell); though it should be noted that any of the available chemical energy that is not converted into electrical energy in the cell (owing to polarisation and resistance losses) will appear as heat and thus help to maintain the operating temperature. More serious difficulties may arise through the corrosive and disintegrating action of molten salts at high temperatures on structural components of the cells. These are problems which industrial users of molten salts have no doubt largely solved, and it has always seemed to the present writer that, if there is any prospect at all for high-temperature fuel cells, the producers of aluminum should be in the best position to develop them and should

have the greatest interest in doing so in view of their being among the largest users of direct current.

In such fuel cells a variety of electrolytes have been tried, especially molten carbonates, silicates, borates and hydroxides of the alkali metals, and various low-melting mixtures of such salts. Melts containing oxides of metals with two or more stable valency states to act as oxygen carriers have also been investigated, as in the recent exploratory work carried out at the British Coal Utilisation Research Association by J. H. McKee and A. M. Adams.

As an oxygen electrode at temperatures of 1000° C or more, molten silver is almost ideal as it dissolves notable amounts of oxygen and facilitates its ionisation. At lower temperatures metal oxides with sufficiently high oxygen dissociation pressures have been used with advantage, e.g. Fe_3O_4 at 800-900° C.

Cells for the direct oxidation of carbon have been investigated, especially by E. Baur and collaborators, e.g. C | molten sodium silicate or borate | (molten silver), O_2 at 1000° C. For continuous operation it would seem necessary, however, to supply carbon of reasonable purity and appropriate physical form. The use of coal itself would be likely to cause difficulties, and material such as gas carbon would certainly be too expensive; carbonaceous material fed in as a self-baking electrode of the Soderberg type might have possibilities.

Hydrogen oxidation cells have been investigated in some detail. Thus cells of the type—H_2 (Fe) | molten sodium and potassium carbonates | (Fe_3O_4), O_2 (air) at 800-900° C, developed by Baur, gave a promising performance, using magnesia diaphragms to prevent undue "wetting" of the granular electrode materials by the electrolyte while providing adequate electrical contact between them. These diaphragms were notably attacked by the electrolyte, however, and their use would in any event add to the internal resistance of the cells. There is scope here for improved designs, involving perhaps the employment of more modern types of refractories and of electrode materials of different nature and form. Cells of this type have the advantage of being capable of operating on carbon monoxide as well as hydrogen and might even be fed with mixtures of these substances derived from water-gas.

Recently published E.M.F. measurements (Rose, Davis and Ellingham) on cells of the type—Sn (molten) | SnO_2 in molten sodium hydroxide | (Ag or Pt), O_2 point to the possibility of such system being used as an indirect fuel cell, if metallic tin could be periodically or continuously recovered from the electrolyte by carbon reduction.

There is no doubt that fuel cells of various types with molten salt electrolytes can be designed to convert a substantial proportion (certainly over 30 per cent.) of the chemical energy of the oxidation of carbon to electrical energy. Current densities in continuous operation are limited by polarisation and resistance factors, which may be seriously affected by the build-up of impurities in the electrolyte. The higher the current density that can be taken from a cell without serious

polarisation, the smaller is the area of electrode surface to be provided—and, in general, the smaller the volume of the cell—for a given output of electrical energy; raising the permissible current density is therefore an important object of design. There are many advantages in raising the temperature of operation but, if this is carried too far, they are eventually outweighed by reduction in available energy, increased heat and material losses and higher maintenance costs. In this connection, more attention might be given to the possibility of linking cell reactions consuming secondary fuels with the corresponding processes for production of the fuel from carbon. If these two operations could be conducted at the same temperature and in direct physical association with one another, the attainment of improved heat economy in continuous operation should be facilitated and the handling of materials simplified.

No satisfactory solution of the fuel cell problem is immediately in sight—but the possibility of finding such a solution should not be ruled out.

Powerful Part of ACTH Separated

➤ THE MAN who first isolated ACTH now has a purer, more powerful and less harmful form of the famous "anti-arthritis" hormone.

He is Dr. C. H. Li, professor of biochemistry at the University of California, who has been in Sweden directing a project aimed at synthesizing the hormone. There eventually may be produced a substance which would overcome the shortage of ACTH and would minimize the harmful side effects resulting from continued administration of the whole hormone.

Three patients in Sweden were treated with the new, purer fraction. So powerful is the new fraction that 3 milligrams per day will give the same result as 100 milligrams of ACTH—the usual dosage. The patients all derived the same beneficial effects from the fraction as they do from the whole ACTH.

Since so much less hormone need be administered, the side effects—such as generation of diabetes and generally disturbance of carbohydrate metabolism—were diminished.

Real progress has been made in the direction of synthesizing the new ACTH fraction. It has a molecular weight of about 1,000, within the limits for synthesis; whereas whole ACTH has a molecular weight of about 20,000, so large as to be beyond synthesis. The fraction is called a peptide mixture, composed of eight amino acids. In some way this mixture retains the biological activity of the whole hormone.

Two large projects are devoted to attempts to synthesize the hormone and evaluate its biological properties. One in Sweden is at Upsala, where the Medical Research Council of Sweden has placed at his disposal extensive facilities and a budget of 200,000 crowns. There he is working in association with Dr. Arne Tiselius, Swedish Nobel Laureate. Dr. Li is directing a similar project at Berkeley.

"Tall" as a Pine Tree
Identifies Useful Oil

Tall Oil

Reprinted from "For Instance" of American Cyanamid Co.

➤ Wood is one of Nature's choice gifts to man. Since it is readily available we are apt to accept it rather casually but, where can you match the rich beauty of mahogany, the sturdiness of oak, the durability of cedar or the versatility of pine? And of course the discovery of resinous glues has made possible even greater performance for wood in the form of plywood.

A few of the major products from pine trees are houses and furniture, rosin, turpentine and pine oil, paper and paperboard, and the relatively new commodity, tall oil. Although tall oil constitutes only 2% or 3% of the pine wood used for paper making, there is a potential supply of about 150,000 tons per year. Formerly it was burned with the "black liquor" from the paper-making process but the general shortage of fats throughout the world stimulated research for its recovery.

Its name started in Sweden as "tallolja" which is Swedish for pine oil. But this name is quite confusing because the English term pine oil refers to an entirely different material. In Germany the difficulty was overcome by giving it the pseudonym "tallöl," a combination of Swedish "tall" for pine and German "öl" for oil. After crossing the Atlantic it seems logical that this should become "tall oil" since, from its composition, we could not call it pine oil. However, tall oil has a rather strange connotation and might prompt the question, "How tall is this oil?" Needless to say the chemist is not concerned with some hypothetical height it might have, but he has found many uses for tall oil in industry.

Tall oil is now available in both crude and refined grades for use in paint and varnish, linoleum, soap, lubricants, mineral flotation agents and products for many industries. Efficient processes have also been developed to "split" it into its component parts which are chiefly fatty acids and high grade rosin.

And so, through efficient methods for the recovery of valuable products from former waste, many millions of dollars will be added to our national income each year.

A wine company at St. Catherines, Ont., has converted to making apple sirup from windfalls and culls; the sugar content of the product will be 60% and it will be prepared as a table sirup or for use in cigarettes.

A eucalyptus tree in Australia was called in 1788 a peppermint tree by an English doctor because its leaves yielded an essential oil which removed colicky complaints among members of his crew.

Nylon and Orlon
Joined by Fiber V

Three Synthetic Fibers Cooperate

➤ New fabric blends superior to any textile now in use will be available in the future, Dr. J. B. Quig of E. I. du Pont de Nemours & Company, Wilmington, Del., told the Southwide Chemical Conference sponsored by the American Chemical Society's Georgia Section and the Southern Association of Science and Industry.

By blending the truly synthetic fibers with each other and also with the rayons, cotton, and wool, it will be possible to produce many new fabrics possessing a combination of properties which are superior to those hitherto obtainable.

Dr. Quig said in part: Nylon has contributed so markedly to the variety of textile properties available that it may safely be claimed to have started a revolution. It would be impossible, however, for one fiber to have all the properties which are desired for all uses.

Fiber V and Orlon possess properties which will complement those of nylon, and this trio should complete the revolution, which has barely started. That their respective uses will overlap is obvious, but it seems equally apparent that each can and will serve purposes which the other cannot do as well.

It appears that truly phenomenal wear life can be obtained with nylon; outstanding resilience can be offered by Fiber V; while topnotch weathering, extremely light weight and moderate resilience are characteristic of Orlon.

These three synthetic fibers as a class have properties not possessed by other fibers. Principally, these properties are high strength, water insensitivity (quick drying, dimensional stability, equivalent wet and dry properties), ability to be heat-set, freedom from insect and mildew damage, and —compared with natural fibers— economy in mill processing.

Nylon has outstanding abrasion resistance and general toughness. Its luxurious suppleness is destined to be important in lingerie. Its high strength and durability have been employed in heavy-duty tires to economic advantage on a value-per-unit cost basis.

Fiber V, on the other hand, inherently has a high bending modulus which permits the making of sheer, extremely lightweight fabrics (curtains, tulle, voiles, organdies) which are crisp and highly wrinkle-resistant in their natural state without resin treatment. Its high stretch resistance is unique in many sewing applications where fine strong seams are required.

Orlon fiber possesses unusual ultraviolet light and chemical resistance. These properties have been used in outdoor fabrics which greatly out-perform conventional materials in comparative life tests. After 385 days in Florida, an Orlon awning fabric lost only 15 per cent tenacity while cotton lost 60 per cent.

Considering the staple forms of these three fibers, nylon has invaded deeply the knitwear fields of sweaters and socks. Properties of abrasion resistance and easy maintenance have contributed to its rapid acceptance in these uses. For transportation upholstery—for automobiles, buses, trains, and airplanes—the use of this staple is certain to grow rapidly because of its demonstrated ease of maintenance and long wear life compared to other fabrics. Fiber V staple has been used in tropical worsted type suiting to produce fabrics even more resilient than 100 per cent fine wool. The outstanding features of Orlon staple are its warm, wool-like feel and its extremely high bulking power. These properties are expected to be of high value in winter suitings and overcoats that are light in weight but as warm as conventional heavy wool fabrics.

It is becoming more and more evident that no individual fiber will be universally acceptable for all textile purposes.

Acid-Repellent Plastic

➤ PLASTICS now surpass even stainless steel in repelling corrosive acids, reports Dr. Raymond B. Seymour, executive vice-president and technical director of the Atlas Mineral Products Co., Mertztown, Pa.

The plastics are of the type known as phenolic resins, and coatings, chemical equipment and cements derived from them have wide applicability in the chemical, steel, paper, petroleum, food, textile, and plating industries. The phenolic resins are resistant to most common industrial chemicals at temperatures up to 375 degrees Fahrenheit.

Dr. Seymour told of one sixty-foot-long tank which has developed no ulcers in twelve years' service, despite a daily diet of more than 100,000 gallons of boiling sulfuric acid. During this period, the acid had eaten many millions of pounds of iron rust in the process called steel pickling, but the tank itself, protected by a phenolic resin, was unaffected.

The most resistant stainless steel is attacked at a very slow rate and the deterioration is rated on terms of inches per year. However, no such term can be used with phenolic plastics since they are completely unattacked.

Demonstrating the process used to produce these resins, Dr. Seymour heated small amounts of two liquids, carbolic acid and formaldehyde, until a heavy syrup formed. This syrup was then mixed with sand and sulfuric acid, and within a few minutes the entire mass became a hard, acid-resistant solid.

Since acids are used to promote the change from liquids to solids in the manufacture of phenolic plastics, it is no wonder that acid has no harmful effect on the plastics.

A ton a day of citric-acid crystals is the expected output of a new plant at Fazenda, Brazil.

Kills Germs in Water Without Spoiling Taste

Chlorine Dioxide Sterilizes Water

➤ A CHLORINE compound sterilizes drinking water as effectively as the element itself, but without imparting an unpleasant "chlorine taste."

The compound is chlorine dioxide, and it already has made an important place for itself in the water treatment industry. As a means of both taste and odor control the compound has been found to equal or surpass chlorine as a germ-killer.

Dr. R. N. Aston of the Mathieson Chemical Corporation, Cincinnati, delivered a report to the Southwide Chemical Conference held in Atlanta by the American Chemical Society's Georgia Section and the Southern Association of Science and Industry.

Generally chlorine dioxide is as economical as other methods for taste and odor control, Dr. Aston said. In some instances where it may be greater in cost, the increase is justified by superior results esthetically and biologically. While not immediately advocated in all cases as a bactericide, owing to economics, chlorine dioxide in many waters—due to ammonia content or other factors causing high chlorine demand—may be more economical than chlorine.

Chlorine dioxide, although known as a chemical compound since 1802, has been readily available for only about ten years. It is a gas so unstable it cannot be bottled or shipped, and must therefore be made at the point of use from a powder known as sodium chlorite. Chlorine dioxide is widely employed for the bleaching of flour, and also for odor control in soap plants and for the treatment of industrial wastes.

More than 125 cities in the United States and Canada, including Philadelphia and Washington, now use chlorine dioxide to remove taste and odors from water supplies. The compound's bactericidal properties were first reported in 1947. A minute quantity of the substance has been shown to kill the common water pathogens, or disease-causing organisms, within five minutes.

Other researchers have reported, according to Dr. Aston, "that the virus of poliomyelitis is inactivated by practical residuals of chlorine dioxide as well as free chlorine."

One of the advantages obtained by using chlorine dioxide instead of chlorine is that a residual amount of chlorine dioxide travels through the entire water distribution system, thus maintaining the quality of the water right to the consumer's tap. Extensive tests made by the City of Niagara Falls, he said, have shown that when a chlorine dioxide residual is present there is "a definite decrease in consumer complaints," indicating that the water is "completely satisfactory bacteriologically and esthetically."

The Chinese, hundreds of years ago, conceived the idea of ball bearings made of leather.

Metals, Oil, Wood, Plastics Improved By New Inventions

Recent Chemical Patents

Copies of complete specifications may be ordered from the Commissioner of Patents, U.S. Patent Office, Washington 25, D.C. Order by patent number and remit 25 cents for each patent, by money order or Patent Office coupon, not stamps.

Stainless Steel Colored

➤ STAINLESS Steel in many colors, for ornamental use and for interior fixtures and furniture, varies from yellow through green and blue to purple when treated chemically in a process which has received a patent.

This now widely-used, rust-resistant steel alloy is ordinarily of a dull or satin-like appearance if unpolished, but has a mirror-like metallic hue when finished. It can be painted, of course, but paint coatings are usually unsatisfactory because they do not tie in properly with the properties of the steel.

In this process, the colors are obtained by chemical action with the metal surface. The steel is immersed in a bath of water to which a small quantity of phosphoric acid has been added. The acid is by weight from 0.25% to 5% of the solution.

The steel remains in the solution for a period ranging from 20 minutes to 20 hours. A colored, thin, translucent, and usually somewhat iridescent, film forms on the surface. The bath is kept at about the boiling point. Full color is seldom obtained in less than 20 minutes, and appreciable changes in color are obtained up to 20 hours.

Patent 2,521,580 was issued to Regina L. Hornak, Baltimore, Md., and John J. Halbig, Middletown, Ohio, for the process. Rights have been assigned to Armco Steel Corporation, Middletown.

Wood Pulp Process

➤ IMPROVED REFINED wood pulp, for paper making, is obtained by a process which gives a uniform composition regardless of the many different types of wood, such as pine, spruce and hemlock, from which the pulp originates. The inventor is Kenneth Russell Gray, Shelton, Wash. Patent number 2,518,680 was awarded to him. He has assigned his rights to Rayonier Inc., of the same city.

The patent is for a chemical process which obtains the essential uniformity of pulp composition with respect to ether extract by ascertaining the kinds and proportions in the pulp and then adding oil-soluble unsaponifiable materials or fatty or resin acid soap-forming materials.

High Octane Gasoline

➤ HIGH OCTANE gasoline, a war essential, is obtained from carbon oxides and hydrogen in the presence of a suitable catalyst in an improved process for which the government has issued a patent. The method is used in obtaining liquid fuels from natural gas.

Patent 2,518,315 was awarded to Charles E. Hemminger of Westfield, N. J., for this process. Rights have been assigned to the Standard Oil Development Company. Straight run gasoline having research octane numbers up to 75 is being obtained by other processes, but the products of this method have considerably higher octane numbers.

In the process, carbon monoxide and hydrogen in proper proportions are mixed with a dense, turbulent, fluidized mass of finely divided iron catalyst at temperatures within the range of 700 to 750 degrees Fahrenheit. Any conventional equipment adapted to fluid catalyst operation can be used.

Cold Pressure Welding

➤ WELDING such metals as aluminum and copper without the use of hot flames or electric arcs is possible with a cold pressure process on which a patent has been issued. It can be used with many non-ferrous metals.

Patent 2,522,408 was issued to Anthony Bagnold Sowter, Wembley, England, for this process. Rights have been assigned to General Electric Company, Limited, London.

As described by the inventor, the process involves bringing the metals to be welded into contact with each other. Then by the application of pressure, the metals are caused to flow away from the welding point and into interleaved relation with the grains of the metals being welded.

Before welding, oxide films and other impurities on the metals are removed. In aluminum welding a pressure of from 12 to 18 tons per square inch is used. With copper, two to four times this pressure is required. The process is carried on at room temperatures. The rate at which the pressure is applied is not material.

Fibers From Zein

➤ FIBERS for fabrics from zein, an extract from corn, that have greater strength than those of wool, are obtained by a process which brought patent 2,521,704 to Cyril D. Evans, Chester W. Ofelt and Allan K. Smith, Peoria, Ill. Rights have been assigned to the U.S. Government as represented by the Secretary of Agriculture.

Zein is a protein extracted from the crude gluten residue obtained as a by-product in the wet milling of corn for the production of corn starch. Fiber has already been made from it but the product usually has poor strength and is brittle.

In this new process, the zein is treated in an alkali metal hydroxide, and the results spun in an acid medium containing a strong mineral acid and an organic acid. The use of expensive organic solvent is eliminated and the elaborate solvent-recovery system used in dry spinning of the fibers is not required.

Sulfur-Free Crude Oil

➤ BETTER GASOLINE is promised from crude oil of the type that contains excessive amounts of sulfur as it comes from the ground. The process to accomplish this involves the use of microorganisms to reduce the sulfur compounds to others which can be easily removed.

Patent 2,521,761 was issued to Raymond J. Strawinski, Long Beach, Calif. The Texaco Development Cor-

poration of New York City has acquired the patent rights.

Gasolines containing an excess of sulfur are corrosive and they also decrease the efficiency of anti-knock compounds. It has been known for some time that certain micoorganisms will attack sulfur compounds and convert them into hydrogen sulfide and water-soluble sulfur compounds. The microorganisms required can be obtained from many sources including mixtures that occur in nature where petroleum products have been stored or spilled. They can also be obtained from animal, marine and vegetable sources, and are found in sewage.

Crushed Hay

➤A NEW MACHINE cuts the hay in the field and crushes it in a single operation. Crushing the hay as soon as cut is now advocated by agricultural scientists. It dries more rapidly than uncrushed hay and thus retains food value, minerals and vitamins. Thurman T. Scott, Thomasville, Ga., is the inventor. Patent 2,521,999 was awarded to him.

Infrared Phosphor

➤INVISIBLE infrared radiation, used in some types of military photography and widely used in industrial rapid-drying processes, is made visible by an improved phosphor which brought Franz Urbach, Rochester, N.Y., patent 2,522,074. The patent has been assigned to the University of Rochester. His phosphor, a material to absorb the infrared radiation and give off visible light, is made up of a base material selected from the group consisting of the sulfides of calcium, strontium and barium containing two activators. One is from the group including cerium, manganese, copper and samarium. The other is from the group containing samarium, bismuth and tin.

Wrought Alloy For Jets

➤WROUGHT alloy, with high strength, ductility and ability to withstand the high temperatures in rotors of jet and gas turbine engines, is a hardened alloy of iron containing nickel, chromium, molybdenum and titanium. It will stand up at temperatures up to 1,300 degrees Fahrenheit. A particular advantage is that this high-grade alloy requires a minimum of scarce or strategic alloying elements.

Patent 2,519,406 was awarded to Howard Scott, Robert B. Gordon and Frederick C. Hull, all of Pittsburgh, Pa. Westinghouse Electric Corporation, East Pittsburgh, has acquired patent rights by assignment.

Bent Glass Sheets

➤A NEW METHOD and apparatus for bending thermoplastic materials and glass sheets for airplane and automobile windshields and for other purposes, permits the economic shaping of heated glass sheets to complicated, compound curvatures of a character that would be extremely difficult otherwise.

In the process, a contour mold of the required shape is employed. The techniques involve supporting the sheet against bending during an initial heating process, and then the bending by the application of mechanical pressure.

Joseph E. Jendrisak, Rossford, Ohio received patent 2,518,896 for his work. Patent rights have been asquired by

Libbey-Owens-Ford Glass Company, Toledo, Ohio.

Green For Beans

➤ THE green color of Lima beans and other legumes frozen for preservation is retained by a process which brought James Ralph Kenworthy, Jr., Modesto, Calif., patent 2,520,214. Rights are assigned to John Inglis Frozen Foods Co. of Stockton, Calif. In the process, the beans, after being depodded, are immersed for a minute or so in a dilute solution of sodium hydroxide.

Self-Packing Pipe Joint

➤ DRAIN pipes, and other piping with the ordinary bell and spigot joints, are united safely against gas or liquid leakage by a plastic ring inside the bell and another around the end of the section to be inserted in the bell. It is a self-sealing joint after the spigot is telescoped into the bell.

The inventor is Albert C. Fischer of Chicago. Patent 2,517,778 was awarded to him. The seal is made without the addition of special adhesives. The material around the spigot end is a plain asphaltic composition. The lining of the bell is a rubberized bituminous material of tacky and adhesive properties, and it is responsible for the seal.

Casein Manufacture

➤ AN improved process for the manufacture of casein from milk, a substance now widely used in making plastics and for other applications, brought patent 2,519,606 to Paul F. Sharp, Piedmont, Calif. Rights have been assigned to Golden State Company, Ltd., San Francisco. The method uses flotation for the removal of casein after coagulation in the form of a foam of high casein content.

Domestic Cobalt Available Soon

➤ MUCH OF THE strategic cobalt needed in producing special steel alloys, and in permanent magnet alloys, may be mined in the United States in the near future.

A larger quantity of domestic cobalt would relieve the present dependency of America on foreign ore. Consumption by American refiners of cobalt contained in alloys and ores is approaching 3,000,000 pounds annually. Belgian Congo is now the chief source of supply. Canada and other countries produce some for American markets.

Years of almost complete dependence upon foreign sources of cobalt will come to an end when production of this vital element begins at the Blackbird Mine of the Calera Mining Company near Forney, Idaho, Edwin B. Douglas, manager, told the American Mining Congress.

Proved reserves at present are sufficient to permit operation of a 600-ton mill for a considerable number of years, he stated. No serious complications are anticipated in mining the ore bodies proved so far.

Difficulties of unusual scope were encountered in treating ore to produce a cobalt and copper concentrate. These, however, have been solved. A satisfactory separation method has been developed. The separation is made by differential flotation methods employing long conditioning at relatively high temperature of pulp.

Proudly Presented

➤ SODIUM CELLULOSE SULFATE, a new water-soluble cellulose gum, is described in a booklet issued by the Tennessee Eastman Corporation. The material forms a thick, viscous liquid when added to water, which the makers recommend for coatings on fibers in textiles and paper as it leaves a strong non-burning film upon evaporation of the water. In its original form, they believe it will be used as a thickener for paints and cosmetic creams, and even for salad dressings and ice cream. The company's New York office at 10 East 40th St., N.Y. 16, offers information on the properties and uses of SCS.

➤ BUNA N CEMENTS and adhesives offered by Hercules under the trade name Vinsol are described in detail in a technical booklet available from the Hercules Powder Co., Wilmington, Del.

➤ CHEMICALS FOR RESEARCH in biological and bacteriological reactions are offered by General Biochemicals Inc., Chagrin Falls, Ohio, in a 36 page catalogue dated August 1950. An alphabetical index makes it easy to find wanted compounds, such as amino acids, carbohydrates, nucleoproteins, purines, pyrimidines, enzymes, microbiological and bacteriological media, complete biological test diets, various test diet ingredients and miscellaneous research biochemicals. Copies of this new publication, listing 224 special products for investigational use in the fields of biology, microbiology, bacteriology, biochemistry and nutrition, are available from GBI upon request.

➤ POLYVINYL CHLORIDE resins and their plasticizers are the subject of a bulletin from Monsanto (Technical Bulletin No. 0-70) which gives formulas for plastic film and sheeting for many purposes. Flame-retandant plasticizers are dealt with in detail, as are those flexible at low temperatures and those proved harmless for use in contact with food. Materials useful for producing plastics with specific physical properties are also included. Manufacturers of plasticizers, stabilizers and vinyl resins and the trade names of their products are listed. Although the bulletin is issued by the St. Louis headquarters of the Organic Chemicals Division, the company promises that information on plastics and Monsanto plasticizers is available from any of its offices.

➤ A THERMOSETTING plastic finish for wood surfaces which hardens by addition of a catalyst just before application, instead of evaporation of a solvent, has just been put on the market by U.S. Industrial Chemicals, Inc. It is called "Aroflint," and is claimed to be two-thirds as hard as glass, but flexible enough to follow the surface of the wood through temperature changes and even denting without breaking. Fire, water and solvents were all applied in a demonstration without marring the surfaces finished with the new coating.